



SERKET



**The Arachnological Bulletin
of the Middle East and North Africa**

**Volume 11
December, 2009**

**Part 3-4
Cairo, Egypt**

ISSN: 1110-502X

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Subscription for volume 11 (2008-2009):

US \$ 25.00 (personal rate), US \$ 35.00 (institutional rate)

Back issues : Volume 1 (1987-1990), Vol. 2 (1990-1992), Vol. 4 (1994-1996), Vol. 5 (1996-1997), Vol. 6 (1998-2000), Vol. 7 (2000-2001), Vol. 8 (2002-2003), Vol. 9 (2004-2005), 10 (2006-2007): US \$ 25.00 (p.r.), US \$ 35.00 (i.r.) per volume
Volume 3 (1992-1993): US \$ 35.00 (p.r.), US \$ 45.00 (i.r.)

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E-mail: el_hennawy@hotmail.com Webpage: <http://serket2008.multiply.com>

ISSN: 1110-502X

Serket (2009) vol. 11(3/4): 79-81.

The first record of genus *Phintella* (Araneae: Salticidae) in the Turkish spider fauna

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Abstract

The spider species *Phintella castriesiana* (Grube, 1861), of genus *Phintella* Strand, 1906, was found in Turkey to represent a new record for the Turkish spider fauna. Its characteristic features, drawings of genitalia and description are presented.

Keywords: *Phintella castriesiana*, Salticidae, Spiders, Turkey.

Introduction

The spiders of the family Salticidae are characterized by the square fronted carapace, with four large, forward-facing eyes, a smaller pair one each side further back, and a scarcely visible pair one each side between front and rear eyes (Roberts, 1995). The family Salticidae is the species richest group of spiders, which includes 5237 species in 567 genera with worldwide distribution (Platnick, 2009). This family is rather poorly known in Turkey when compared with other regions of the world. There are 71 species of 29 genera recorded in the country (Topçu *et al.*, 2005). This is the first record in Turkey for the species, *Phintella castriesiana* (Grube, 1861), and its genus *Phintella* Strand, 1906.

Material and methods

This study is based on a specimen collected from northern Turkey and preserved in 70% ethanol. The identification was made by a SZX61 Olympus stereomicroscope, using the papers of Prószyński (1976) and Metzner (1999). Examined specimen is deposited in the Arachnology Museum of Niğde University (NUAM). All measurements are in millimetres.

Results

Phintella castriesiana (Grube, 1861)

Material examined. Turkey: Kastamonu province, Yarören village, (41°21'366"N, 33°40'335"E), 1125 m, on the leaves of shrubs, 29.VII.2008, (1♀), leg. T. Türkeş.

Description

Measurements: Total length 4.4 mm. Carapace length 2.3 mm, width 1.7 mm. Abdomen length 2.2 mm, width 1.4 mm.

Prosoma dorsally light orange, eye field black from eye edge, posterior lateral eyes with brown rings around, sloping sides with black drawing. Frontal part of cephalic area and its sides with white hairs. Clypeus with sparsely transparent hairs. Labium with three wedge-shaped black stripes. Maxilla orange with light distal part. Sternum light orange. Opisthosoma dorsally light orange with dark reticulate drawing, ventrally light with vague longitudinal dark strip. Legs uniformly light with translucent hairs.

Comments

Determination was made after Prószyński (1971, 1976, 1978, 1983), Hansen (1986), Matsumoto (1989) and Logunov & Wesołowska (1992). The synonymy was discussed by Prószyński (1983). Habitat type was represented by Logunov & Wesołowska (1992) as grass and mixed forest. Ovtcharenko (1978) found *P. castriesiana* in the Caucasus by the shores of the Black Sea.

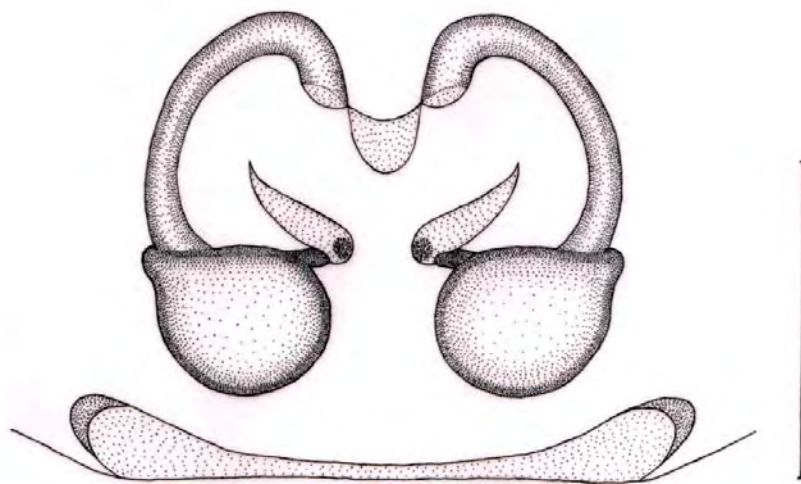


Fig. 1: Dorsal view of vulvae of *Phintella castriesiana* (Grube, 1861).
Scale bar: 0.25 mm.

Acknowledgment

The authors acknowledge the Scientific and Technological Research Council of Turkey (TUBITAK) (Project No. 107T017) for financial support of this work.

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Spiders (Araneae) new to the fauna of Turkey. 7. New species and genera records of Linyphiidae

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Abstract

Four genera and six species of the family Linyphiidae are reported from Turkey for the first time: *Centromerus minor* Tanasevitch, 1990; *Diplocephalus picinus* (Blackwall, 1841); *Hypomma bituberculatum* (Wider, 1834); *Maso sundevalli* (Westring, 1851); *Metopobactrus prominulus* (O. P.-Cambridge, 1872) and *Micrargus herbigradus* (Blackwall, 1854). Geographical distribution of the species is discussed.

Keywords: Spiders, Linyphiidae, new records, Turkey.

Introduction

The present paper is the seventh in a series on new spider records from Turkey. It is devoted to Linyphiidae. The earlier papers were devoted to Theridiidae (Marusik *et al.*, 2009; Marusik & Kunt, In press-a), Hahniidae (Marusik & Kunt, 2009), Clubionidae (Marusik & Kunt, In press-b), Anyphaenidae (Marusik, In press-a) and Araneidae (Marusik, In press-b).

Linyphiidae is the second largest family with 4365 species worldwide distributed (Platnick, 2009). It is also one of the most species-diverse families in Turkey with 65 species (Bayram *et al.*, 2008). During joint Turkish-Russian Arachnological trip in May – June 2009, several dozens of additional species and even genera have been collected in Turkey including four genera and six species of Linyphiidae.

Methods

All specimens were collected during the Turkish-Russian Arachnological expedition in 27 May – 14 June 2009. Eight provinces: Ankara [T-01], Bolu [T-04],

Kastamonu [T-06, 07], Bursa [T-09, 10], İzmir, Aydın, Antalya and Artvin [T-19, 20] provinces were visited during the collection trip (Map 1).

The specimens were collected by sweeping net, hand picking, litter sifting and tree branch beating with the help of aspirator. They were preserved in 70% ethanol. Specimens were photographed using an Olympus Camedia E-520 camera attached to an Olympus SZX12 stereomicroscope. The images were montaged using “CombineZM” image stacking software. Photographs were taken using dishes of different size with paraffin in the bottom. Different sized holes were made in the bottom to keep the specimens in the correct position. Each species entry is supplied with the most appropriate identification references (chiefly well known identification books).

Material treated herein is deposited in the Turkish Arachnological Society collection and in the Zoological Museum of the Moscow State University.



Map 1. Distribution of species newly recorded in Turkey. Numbered dots correspond to the localities studied during Turkish-Russian expedition in 2009. Locality numbers are indicated in “Material examined”: [T-1, 4, 6, 7, 9, 10, 19, 20].

Taxonomic survey

Centromerus minor Tanasevitch, 1990

C. m. Tanasevitch, 1990: 13, f. 4.1-4 (♂♀).

Material examined: 1♀ [T-19] Artvin Province, Şavşat District, Meydancık Town, Erikli Village, 41°24.302'N, 42°17.809'E, 1141 m, litter in oak-spruce forest, 12.06.2009 (Yu.M.Marusik).

Comments. Although Platnick (2009) listed distribution of this species as “Russia, Central Asia”, it was known exclusively from Caucasus, from the northern macroslope of the Caucasus Major to southernmost Armenia (cf. Otto & Dietzold, 2009). Beside Russia (northern Caucasus) and Armenia, *C. minor* was reported from eight localities in Georgia and six localities in Azerbaijan (Tanasevitch, 1990). The record of this species from Artvin Province of Turkey does not extend the known range to the west or south. *C. minor* is the third species of the genus in Turkey.

Diplocephalus picinus (Blackwall, 1841)

D. p.: Wiehle, 1960: 515, f. 951-960 (♂♀).

D. p.: Roberts, 1987: 86, f. 37c, 39j (♂♀).

D. p.: Tanasevitch, 1990: 111, f. 22.24, 24.44, 28.12 (♂♀).

Material examined: 2♂♂ 3♀♀ [T-04] Bolu Province, Abant, 40°40.656'N, 31°28.313'E, 1308 m, litter in *Pinus* and mixed *Pinus-Fagus* forests, 28.05.2009 (Yu.M.Marusik); 2♂♂ 14♀♀ [T-06] Kastamonu Province, Azdavay District, 41°41.938'N, 33°25.971'E, 975 m, 30.05.2009 (Yu.M.Marusik); 6♀♀ [T-09] Bursa Province, Uludağ National Park, 40°06.970'N, 29°03.283'E, 648 m, litter in mixed *Quercus*, *Fagus*, *Pinus*, etc., 1.06.2009 (Yu.M.Marusik); 1♀ [T-10] Bursa Province, Nilüfer District, 40°07.466'N, 28°42.105'E, 570 m, 2.06.2009 (Yu.M.Marusik).

Comments. Platnick (2009) treated this species as Palearctic although it has West Palearctic range and restricted to Europe, Turkey and Caucasus. In Europe, it is known from Ireland to Ural, south to Spain and Bulgaria. In Caucasus, *D. picinus* was reported from all four states: Russia, Armenia, Azerbaijan and Georgia (Otto & Dietzold, 2009). Records from Turkey extend the known range of this species in Asia slightly to the south. It is the fourth species of the genus reported from Turkey.



Figs. 1-4: Male of *Hypomma bituberculatum* (1-2) and female of *Maso sundevalli* (3-4). 1. habitus, lateral. 2. prosoma, lateral. 3. habitus, dorsal. 4. epigyne, ventral.

Hypomma bituberculatum (Wider, 1834) Figs. 1-2.

Enidia bituberculata: Wiehle, 1960: 290, f. 529-537 (♂♀).

H. b.: Roberts, 1987: 44, f. 13d, 16j (♂♀).

Material examined: 1♂ 1juv. [T-06] Kastamonu Province, Azdavay District, 41°41.938'N, 33°25.971'E, 975 m, shaking branches of *Quercus* and *Fagus*, 30.05.2009 (Yu.M.Marusik).

Comments. *Hypomma* is a genus new to Turkey. Although *H. bituberculatum* has trans-Palaearctic range and known from almost all European states (except for Portugal and Greece and some small states), it was never reported from Turkey. This species can be easily recognized due to characteristic modification of carapace in male and shape of the male palp (Figs. 1-2).

Maso sundevalli (Westring, 1851) Figs. 3-4.

M. s.: Wiehle, 1960: 20, f. 9-14 (♂♀).

M. s.: Roberts, 1987: 54, f. 20a (♂♀).

M. s.: Tanasevitch, 1990: 108, f. 22.35, 24.46, 28.30 (♂♀).

Material examined: 1juv [T-01] Ankara Province, Kızılcahamam District, Soğuksu National Park, Göllü Area, 40°27.359'N, 32°35.602'E, 1800 m, dead litter in pine-spruce forest, 27.05.2009 (Yu.M.Marusik); 1♀ [T-04] Bolu Province, Abant, 40°40.656'N, 31°28.313'E, 1308 m, litter in *Pinus* forest, 28.05.2009 (Yu.M.Marusik); 1♀ [T-06] Kastamonu Province, Azdavay District, 41°41.938'N, 33°25.971'E, litter in oak forest, 975 m, 30.05.2009 (Yu.M.Marusik); 2juv. [T-07] Kastamonu Province, Between Kastamonu-Çankırı road, 29 km from the Ilgaz District, 41°05.862'N, 33°44.844'E, 1520 m, litter in spruce forest, 31.05.2009 (Yu.M.Marusik); 9♂♀ [T-20] Artvin Province, 9 km NWW of Artvin, 41°15.642'N, 41°46.365'E, 225 m, 13.06.2009 (Yu.M.Marusik).

Comments. *Maso* is a genus new to Turkey. Although *M. sundevalli* has circum-Holarctic range and known from many states it was never reported from Turkey, while known from adjacent Bulgaria (Helsdingen, 2006) and Georgia (Otto & Dietzold, 2009). Members of this genus can be easily recognised from all other Turkish Erigoninae even in juvenile stage due to the presence of ventral femoral, tibial and metatarsal spines on legs I and II (cf. Fig. 3).

Metopobactrus prominulus (O. P.-Cambridge, 1872)

M. p.: Wiehle, 1960: 246, f. 446-451 (♂♀).

M. p.: Roberts, 1987: 46, f. 14c, 17c (♂♀).

M. p.: Tanasevitch, 1990: 54, f. 16.9-11, 24.53 (♂♀).

Material examined: 1♂ 1♀ [T-20] Artvin Province, 9 km NWW of Artvin, 41°15.642'N, 41°46.365'E, 225 m, 13.06.2009 (Yu.M.Marusik).

Comments. *Metopobactrus* is a genus new to Turkey. Although *M. prominulus* has Holarctic range and known from many European countries, it was never reported from Turkey. It is unknown from adjacent Armenia, Bulgaria, Greece and Georgia (Helsdingen, 2006; Otto & Dietzold, 2009), but it is reported from Azerbaijan (Otto & Dietzold, 2009).

Micrargus herbigradus (Blackwall, 1854)

M. h.: Wiehle, 1960: 262, f. 476-483 (♂♀).

M. h.: Roberts, 1987: 80, f. 34d, 38g (♂♀).

M. h.: Tanasevitch, 1990: 104, f. 22.38, 24.55 (♂♀).

Material examined: 1♀ [T-06] Kastamonu Province, Azdavay District, 41°41.938'N, 33°25.971'E, 975 m, litter in oak forest, 30.05.2009 (Yu.M.Marusik).

Comments. *Micrargus* is a genus new to Turkey. Although *M. herbigradus* has trans-Palaeartic range and known from almost all European countries (Helsdingen, 2006) and all Caucasian states (Otto & Dietzold, 2009), it was never reported from Turkey. This species can be easily recognized due to the shape of copulatory organs. Females of this species have unusually deep, for Erigoninae, epigynal fovea.

Conclusion

Although Linyphiidae is one of the most species diverse families in Turkey, number of species reported in the country (71) is very low. Adjacent, much smaller, countries such as Georgia and Azerbaijan have higher species diversity (87 and 100 respectively). There is no doubt that real diversity of Linyphiidae is at least twice higher. Beside six species new to Turkey reported in this paper, we collected during our joint trip about 30 unidentifiable species, some of which most probably belong to undescribed genera.

Acknowledgments

We thank Altuğ Kızıltuğ, Ersen Aydın Yağmur, Dr. Rahşen S. Kaya for their valuable help during field studies. This work was supported in part by the RFFI grants # 09-04-01365-a and 08-04-92230.

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The first record of genus *Neospintharus* Exline, 1950 (Araneae: Theridiidae) from Turkey

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Abstract

The theridiid spider *Neospintharus syriacus* (O. P.-Cambridge, 1872) is recorded for the first time from Turkey. This represents a new spider genus and species record for Turkey. The characteristic features and drawings of both sexes are presented in this study.

Keywords: *Neospintharus syriacus*, new record, Theridiidae, Turkey.

Introduction

The family Theridiidae Sundevall, 1833 is one of the most diverse families of spiders, with 2295 species in 109 genera (Platnick, 2009). Sociality and kleptoparasitism commonly occur in the subfamily Argyrodinae among theridiid spiders (McCrater & Uetz, 2009). Argyrodinae comprises six genera: *Argyrodes* Simon, 1864, *Ariamnes* Thorell, 1869, *Faiditus* Keyserling, 1884, *Neospintharus* Exline, 1950, *Rhomphaea* L. Koch, 1872, and *Spheropistha* Yaginuma, 1957. The latter five genera have recently been removed from synonymy with *Argyrodes* (Agnarsson, 2004). *Neospintharus* Exline, 1950 is a small theridiid genus which contains 12 species and mostly occurs in tropical, subtropical and warm regions of the world (Platnick, 2009). Members of the genus are either kleptoparasitic or araneophagic, usually found in webs of other spiders and they can be easily recognized by their distinct abdominal pattern. Only one species, *Neospintharus syriacus* (O. P.-Cambridge, 1872), occurs in the Mediterranean region (Levy, 1985; Platnick, 2009). So far, 31 species of Theridiidae belonging to 9 genera have been recorded in Turkey, but no member of the genus *Neospintharus* Exline, 1950

has been recorded until now (Karol, 1967; Bayram, 2002; Topçu *et al.*, 2005). This work adds *N. syriacus* (O. P.-Cambridge, 1872) as a new record of the species and genus to the theridiid spider fauna of Turkey.

Material and Methods

Studied specimens were collected by the second and third authors from four different localities in Turkey (Fig. 1):

Locality 1. Hatay [Samandağ, Çevlik (36°07'13.67"N, 35°55'31.89"E)]: Four females and one male specimen were collected in Titus (Vespasianus) Tunnel, from the webs of Pholcidae (*Pholcus* sp.) and Theridiidae (*Steatoda* sp.), on 17 June 2008; five females and one male specimen were collected in Titus (Vespasianus) Tunnel, from the webs of Pholcidae (*Pholcus* sp.), on 11 May 2009.

Locality 2. Mersin, [Silifke (36°22'33.93"N, 33°53'28.56"E)]: One female was collected from Silifke – Mut road on 7 May 2009. The specimen was collected from the web of Pholcidae.

Locality 3. Antalya [Muratpaşa (36°50'50.71"N; 30°45'47.22"E)]: Two females and one male were collected from the webs of Pholcidae on 25 September 2009.

Locality 4. Osmaniye [Bahçe, Aşağı Arıcaklı Village (37°11'28.73"N, 36°36'29.37"E)]: Five females and one male specimen were collected from the webs of Araneidae on 4 May 2008.

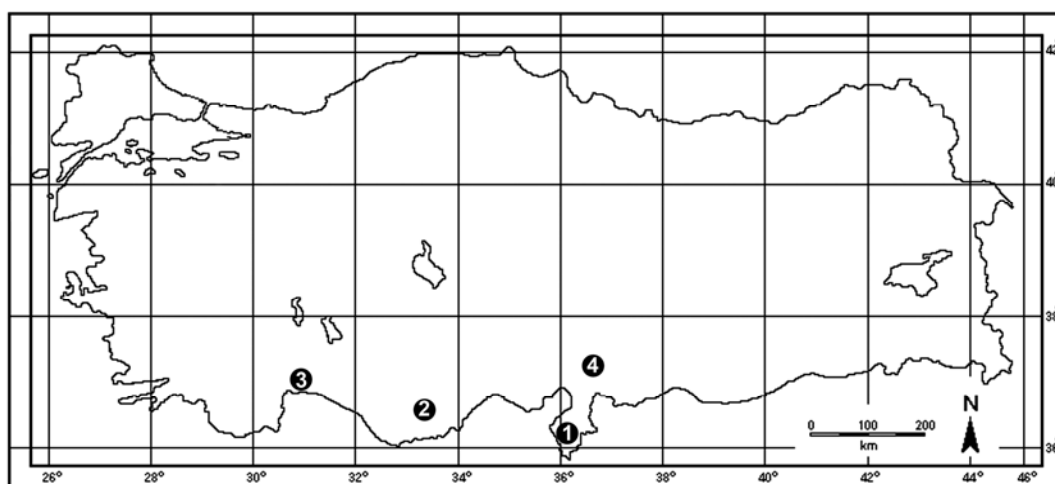
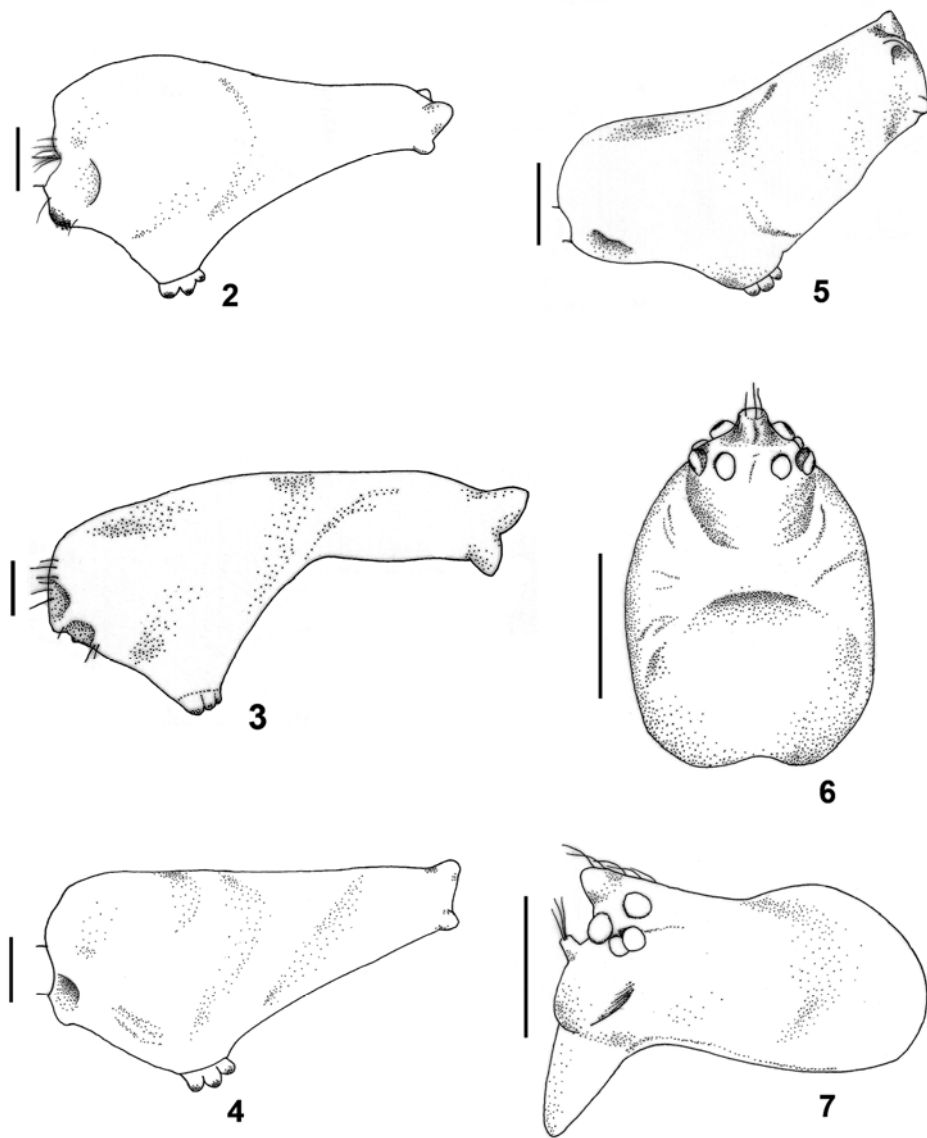


Fig.1. Positions of the collecting sites from which the specimens were collected:
1. Hatay (Samandağ, Çevlik), 2. Mersin (Silifke - Mut), 3. Antalya (Muratpaşa),
4. Osmaniye (Bahçe, Aşağı Arıcaklı Village).

The identification was made using the descriptions of Levy (1985, Figs. 40-43). The drawings were made by the means of a camera lucida attached to the Zeiss Stemi SR microscope and the measurements were taken with an ocular scale bar by Olympus SZ51. Digital images of palpus and epigynum were taken with a digital camera (Leica DFC290, Germany) that was connected to the optical tube of a stereo microscope (Leica M205 C, Leica Microsystems GmbH, Wetzlar, Germany) and five to 15 photographs were taken in different focal planes and combined. All measurements are in mm. Measurements are taken from the dorsal side of the palps and legs.

The taxonomy follows Platnick (2009) and the terminology of male palpus follows Levy (1985).



Figs. 2-7: *Neospintharus syriacus* (O. P.-Cambridge, 1872). 2-4. Variations of female abdomen, lateral view. 5. Abdomen of male, lateral view. 6-7. Male carapace. 6. dorsal view. 7. lateral view. Scale bars: 0.5 mm.

Results

Family Theridiidae Sundevall, 1833

Genus *Neospintharus* Exline, 1950

Type-species: *N. parvus* Exline, 1950 by original designation and monotypy
(type specimen lost) (Knoflach-Thaler *et al.*, 2008)

Species *Neospintharus syriacus* (O. P.-Cambridge, 1872)

Synonyms

Argyrodes syriaca O. P.-Cambridge, 1872

Description (Figs. 2-12) [Description was done from preserved specimens.]

Female: General body measures were given in Table (1). Carapace longer than wide, dark brown, with some dark annulations, marginal line black. A transverse thoracic depression is present on carapace. Eye region and clypeus high. Clypeus is swollen,

prolonged and brownish in colour. Clypeus height about 4-4.5 times of the anterior lateral eye. Chelicerae are brownish, without spots. Eyes in two rows, anterior row of eyes recurved, posterior row slightly procurved. Labium wider at the base. Sternum, longer than wide, dark brown with yellow spots, bordered by a thin black line. Legs brownish with some dark annulations, some spines arranged irregularly. Legs length formulae: Leg I > Leg IV > Leg II > Leg III. For leg and pedipalp measures see Table (2). Labium and endites pale brown. Abdomen is rounded at the front, narrowed near the posterior point, longer than high, triangular shaped laterally and varies greatly in size and in shape (Figs. 2-5). Posterior point of abdomen ending with four projections. Dorsum variable in colour, especially yellowish-brown, mottled white or with silvery patches and darker cardiac mark is present. The cardiac mark is extending with a dark mid-dorsal thin line to posterior end of abdomen (Fig. 8). Venter brown to black mottled.

Male: As female, except for the following: Carapace darker, cephalic region higher than in female, male has a slimmer abdomen, legs darker, thinner and longer than in female. The male distinctly differs in the form of carapace, both clypeal and cephalic projections. Clypeal and cephalic projections bear strong setae and do not bear the eyes (Figs. 6-7). Abdomen dorsum without mid-dorsal dark line.

Table 1. General body measurements (in mm) of *Neospintharus syriacus* (O. P.-Cambridge, 1872). L = length, W = width, TBL = total body length.

	Carapace L	Carapace W	Abdomen L	Abdomen W	TBL
Male	1.11 – 1.16	0.80 – 0.86	1.77 – 1.83	0.83 – 0.87	2.88 – 2.99
Female	1.12 – 1.25	0.80 – 0.85	3.17 – 4.27	1.05 – 1.5	4.29 – 5.52

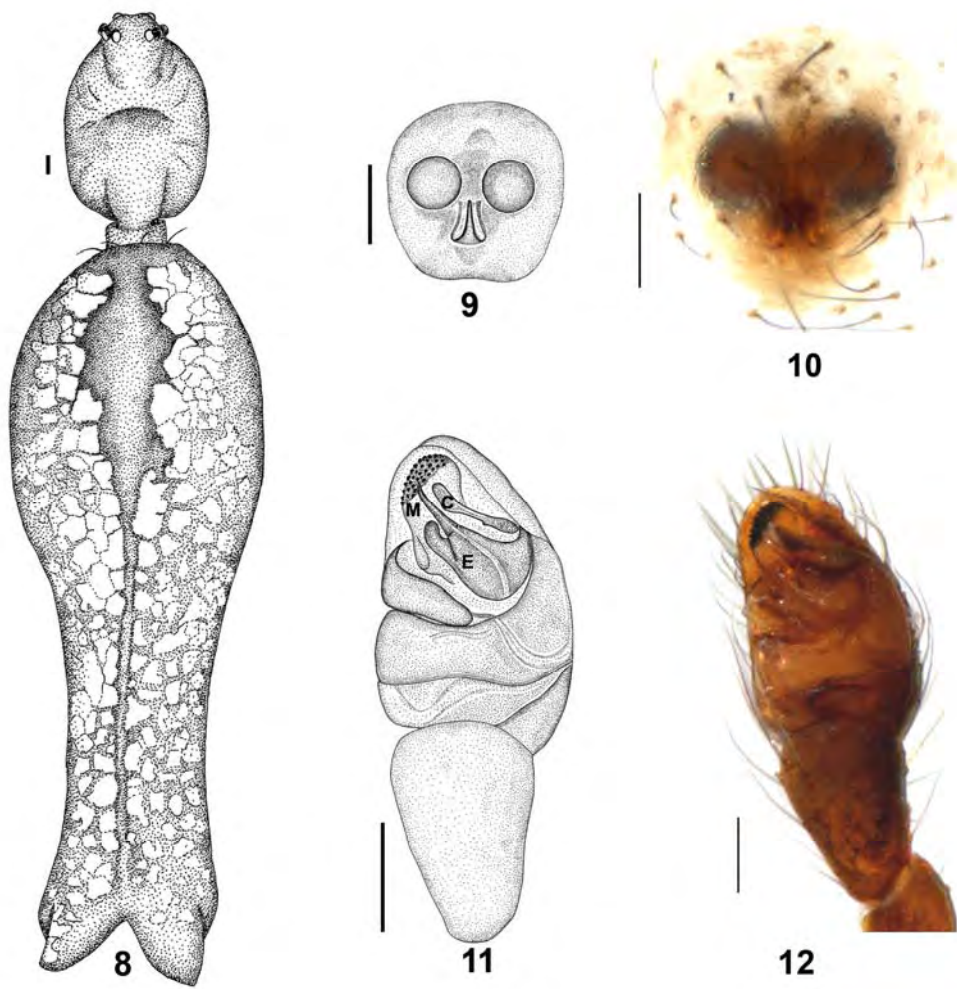
Table 2. Leg and pedipalp measurements (in mm) of male and female specimens of *Neospintharus syriacus* (O.P.-Cambridge, 1872).

		femur	patella	tibia	metatarsus	tarsus
Male	Pedipalp	0.38 – 0.40	0.11 – 0.13	0.12 – 14	–	0.29 – 0.32
	Leg I	2.71 – 2.75	0.27 – 0.31	2.21 – 2.24	2.11 – 2.15	1.10 – 1.12
	Leg II	1.73 – 1.77	0.28 – 0.31	1.29 – 1.33	1.13 – 1.16	0.63 – 0.66
	Leg III	0.6 – 1.0	0.27 – 0.31	0.51 – 0.55	0.58 – 0.63	0.46 – 0.5
	Leg IV	1.93 – 1.97	0.38 – 0.41	1.13 – 1.16	1.08 – 1.11	0.4 – 0.7
Female	Pedipalp	0.32 – 0.4	0.1 – 0.15	0.15 – 0.2	–	0.3 – 0.35
	Leg I	2.8 – 3.07	0.4 – 0.47	2.27 – 2.60	1.62 – 1.75	0.82 – 0.9
	Leg II	1.67 – 1.8	0.27 – 0.42	1.27 – 1.47	1.2 – 1.25	0.72 – 0.77
	Leg III	1.0 – 1.1	0.3 – 0.32	0.52 – 0.57	0.62 – 0.7	0.52 – 0.55
	Leg IV	2.02 – 2.25	0.40 – 0.42	1.22 – 1.35	1.2 – 1.3	0.72 – 0.77

Diagnosis

N. syriacus (O. P.-Cambridge, 1872) can be distinguished from the other known *Neospintharus* species by the following genital characters (Figs. 9-12):

1. Apical part of median apophysis is rough and granulated,
2. embolus with two branches, one longer and pointed, the other short and rounded,
3. conductor spoon shaped,
4. epigynum with triangle shaped median plate.



Figs. 8–12: *Neospintharus syriacus* (O. P.-Cambridge, 1872). 8. Female general habitus, dorsal view. 9-10. Female epigynum, ventral view. 11-12. Male left palpus, retrolateral view. C = conductor, E = embolus, M = median apophysis. Scale bars: 0.1mm.

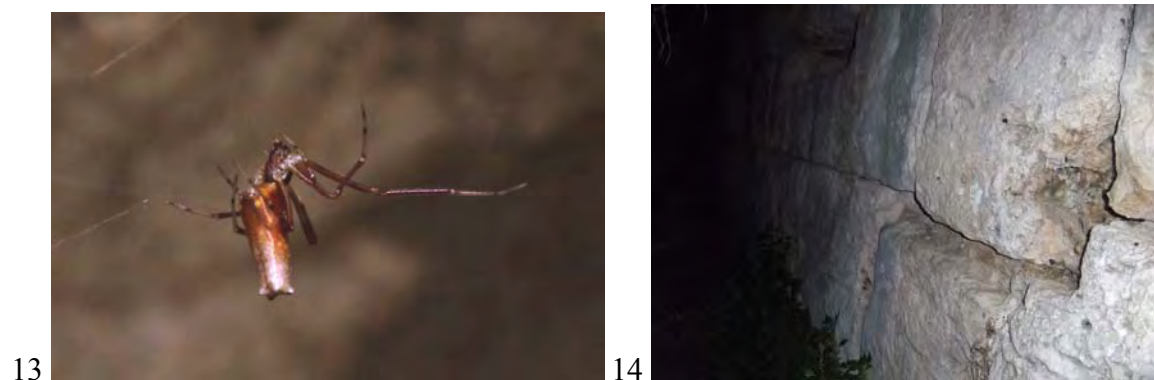


Fig.13. Female *Neospintharus syriacus* (O. P.-Cambridge, 1872) is hanging in a pholcid web upside down. © Photo was taken by Mr. Richard Gallon from Titus (Vespasianus) Tunnel, Çevlik, Samandağ, Hatay. Fig.14. Titus (Vespasianus) Tunnel where *N. syriacus* was collected in Hatay city. © Photo was taken by Kadir Boğaç Kunt.

Habitat and distribution

Cambridge (1872) collected *N. syriacus* on webs of *Cyrtophora* (Araneidae) from Lebanon. Levy (1985) collected most specimens of *N. syriacus* (O. P.-Cambridge, 1872) on water-dripping *Adiantum* ferns. He collected only very few specimens from webs of Linyphiidae and Pholcidae in Israel. More recently, this species was recorded from Greece and Cyprus by Knoflach-Thaler *et al.* (2008) and the authors collected most samples of *N. syriacus* by beating, only a few samples were collected in orb-webs. We collected all of our samples from webs of members of Araneidae, Pholcidae and Theridiidae. The samples were taken their typical positions (hang in the host web upside down) on the host webs (Fig. 13). The majority of our samples were captured in the webs of Pholcidae and Theridiidae among big stones of Titus (Vespasianus) Tunnel (Fig. 14).

N. syriacus (O. P.-Cambridge, 1872) was recorded from Lebanon, Israel, Greece and Cyprus (Platnick, 2009; Knoflach-Thaler *et al.*, 2008). Knoflach-Thaler *et al.* (2008) indicated that this species is more widespread through Mediterranean countries. The recording of this species from Turkey widens its distribution in Mediterranean region.

Acknowledgments

The authors wish to thank Dr. Yuri M. Marusik (Magadan, Russia) and Dr. Barbara Knoflach-Thaler (Innsbruck, Austria) for providing literature. Thanks are due to Mr. Altuğ Kızıltuğ (Ankara, Turkey), Mr. Richard Gallon (North Wales, U.K.), Mr. Guy Tansley (Newcastle, U.K.), Mr. Ray Gabriel (Oxford, U.K.), Mr. Ahmet Bozardıç (Gaziantep, Turkey), Mr. Gökhan Çalışır (Gaziantep, Turkey), and Mr. Erman Tezcan (Gaziantep, Turkey) for their valuable help during our field trips. Also, authors wish to thank Prof. Dr. Gökay Kaynak for allowing to use Leica M205 C Stereo Microscope (Research Foundation of Uludağ University Project No: F-2005/4).

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Genus *Uroctea* Dufour, 1820 (Araneae: Oecobiidae) in Turkey

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Abstract

The *Uroctea* Dufour, 1820 species of Turkey are presented in this study. Until now, only *U. durandi* (Latreille, 1809) is known from Turkey. Here, we record for the first time from Turkey *U. thaleri* Rheims, Santos & van Harten, 2007 which was originally described from Yemen. All available information on these little known Oecobiidae species is presented along with comments on their distribution pattern in Turkey. Also, some characteristic features with photographs of genitalia and general habitus of both sexes are presented.

Keywords: *Uroctea durandi*, *Uroctea thaleri*, Oecobiidae, Spiders, Turkey.

Introduction

The old world genus *Uroctea* Dufour, 1820 is one of the six genera currently belonging to the family Oecobiidae. It was described by the French naturalist Léon Jean-Marie Dufour in 1820 and includes 18 species which are predominantly distributed in the Palaearctic region (Platnick, 2009).

Roewer (1959) first mentioned *Uroctea durandi* (Latreille, 1809) from Adana province of Turkey. However, neither a specimen nor a figure was shown in his paper, this makes comparison with other species impossible. Afterwards, Topçu *et al.* (2006) have been reported *U. durandi* from Adana, Mersin and Niğde provinces.

In the present study, *U. durandi* (Latreille, 1809) and *U. thaleri* Rheims, Santos & van Harten, 2007 of genus *Uroctea* were studied. *U. thaleri* is recorded for the first time in the Turkish araneofauna.

Material and methods

Specimens from the following institutions were examined/cited. Abbreviations, cities and curators are as follows:

MNHN = Muséum National d'Histoire Naturelle, Paris, France (C. Rollard);

MTAS = Museum of Turkish Arachnological Society, Ankara, Turkey (K.B. Kunt);

OUMNH = Oxford University Museum of Natural History, Oxford, England (Z. Simmons);

ZMB = Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (J. Dunlop).

Specimens were photographed using an HP Photosmart R707 camera attached to an Euromex ZE.1654 stereomicroscope. For SEM photographs, the materials were examined at an accelerating voltage of 15 kv under Jeol JSM 6360 LV Scanning Electron Microscope, and the electron micrographs were recorded.

All measurements are in millimetres. Epigynes were dissected and submerged in 5% KOH to study internal structures.

Results

Family **Oecobiidae** Blackwall, 1862

Genus ***Uroctea*** Dufour, 1820

Dufour, *Ann. gén. sci. phys.* v, p. 198, 1820;

Simon, *Hist. Nat. Araign.* i, p. 451, 1893

Uroctea durandi (Latreille, 1809) (Fig. 1).

Material examined: **Antalya Province.** 2 females, Fener Quarter, Muratpaşa District (36°50'52.91"N, 30°46'12.27"E), 02.X.2008, K.B. Kunt leg.; 1 female, Mahmutlar Town, Alanya District (36°29'17.18"N, 32°07'3.90"E), 26.IX.2009, K.B. Kunt leg. **Bursa Province.** 2 females, Firuzköy, Orhaneli District (39°56'23.79"N, 29°06'23.21"E), 18.VI.2007, R.S. Kaya leg. **Erzincan Province.** 1 female, Kozlupınar Village, Kemaliye District (39°12'29.61"N, 38°34'3.20"E), 29.IX.2008, M. Elverici & C. Elverici leg. **Isparta Province.** 1 subadult female, 1 juvenile, National Park of Kovada Lake, Eğirdir District (37°37'45"N, 30°51'41"E), 10.V.2007, R.S. Kaya leg.; 4 females, Ayazmana Quarter (37°44'46.46"N, 30°34'57.88"E), 09.III.2008, K. Bozkurt leg. **İzmir Province.** 1 female, Karagöl, Yamanlar Mountain, Karşıyaka District (38°33'23.30"N, 27°13'2.17"E), 04.X.2008, E.A. Yağmur & S. Anlaş leg. **Mersin Province.** 1 female, Sertavul Pass, Mut District (36°49'9.55"N, 33°19'14.44"E), 06.XI.2004, K.B. Kunt & A.E. Yaprak leg.; 1 female, 1 juvenile, Çamlıyayla, Tarsus District (37°09'58.53"N, 34°36'14.93"E), 12.V.2008, R.S. Kaya leg.; 1 female, Değirmendere Village, Silifke District (36°25'53"N, 33°45'21"E), 13.V.2008, R.S. Kaya leg. **Niğde Province.** 1 female, 2 juveniles, Fertek Quarter (37°58'43.71"N, 34°37'15.55"E), 12.IX.2008, K.B. Kunt leg.

Comments: *U. durandi* has a circum-Mediterranean distribution. It is known in Andorra, Bulgaria, Croatia, France, Greece, Italy, Macedonia, Portuguese, Slovenia and Spain (Helsdingen, 2006). It has been also recorded from England (Selden, 2003). *U. durandi* is mainly distributed in the Aegean and Mediterranean regions of Turkey (Map 1). The morphological and genitalia features of our samples collected from Marmara and East Anatolian region are the same of our samples collected from Aegean and Mediterranean regions. Furthermore, no differences have been observed between Turkish population samples and type material.

Natural History: Specimens were collected in their tent-like webs under stones from dry areas. We observed the remains of millipedes in their webs (Fig. 2).



Map. 1: Distribution of *Uroctea* species in Turkey. **Circles**: sampling localities of *U. durandi*. **Squares**: sampling localities of *U. thaleri*. **Triangle**: Roewer's record (1959).

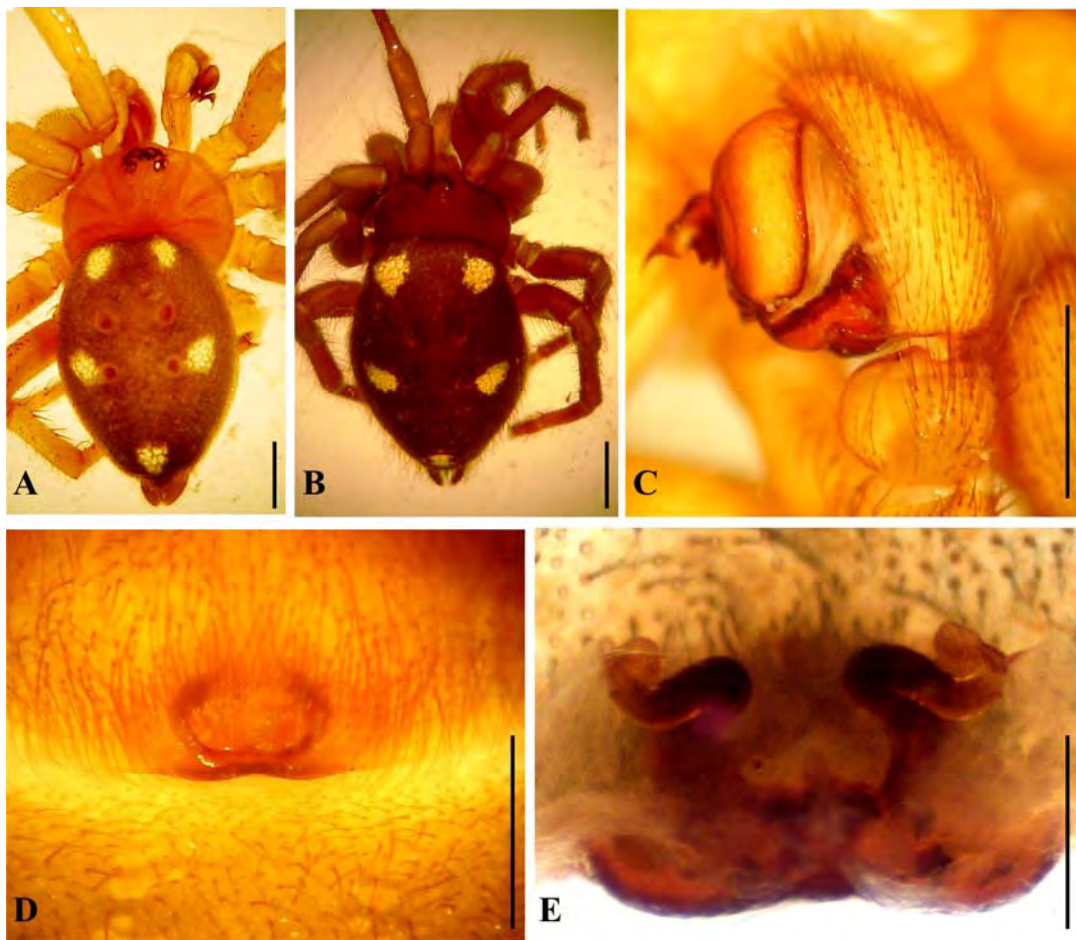


Fig. 1: *Uroctea durandi* (Latreille, 1809). Male, Paratype MNHN AR 10145: A. Habitus, dorsal view. C. Male palp. Female, Holotype MNHN AR 10145: B. Habitus, dorsal view. D. Epigyne, ventral view. E. Internal genitalia, dorsal view. Scale lines: A, B = 1 mm; C, D, E = 0.5 mm.



Fig. 2: Tent-like webs of *Uroctea durandi*. Photos by courtesy of Mr. Kağan Bozkurt, from Ayazmana Quarter, Isparta Province, Turkey.

Uroctea thaleri Rheims, Santos & van Harten, 2007 (Figs. 3-5).

Material examined: **Adıyaman Province.** 1 subadult male, Aydınlar Village, Gerger District, 20.IV.2008, E.A. Yağmur & E. Tezcan leg. **Batman Province.** 1 subadult female, Gercüş District (37°37'28.6"N, 41°24'46.8"E), 17.V.2009, E.A. Yağmur & E. Ulupınar leg. **Diyarbakır Province.** 3 subadult females, Yukarı Kuyulu Village, Ergani District (38°35'8.94"N, 39°15'1.02"E), 13.IV.2008, E.A. Yağmur, G. Çalışır & M. Özkörük leg.; 1 female, Kalkan Village, Eğil District, 14 km southwest (38°08'30.13"N, 40°04'18.99"E), 13.IV.2008, E.A. Yağmur, G. Çalışır & M. Özkörük leg. **Gaziantep Province.** 1 subadult male, Hanağzı Village, İslahiye District (37°04'4.51"N, 36°36'16.79"E), 14.V.2005, E.A. Yağmur & M. Pehlivan leg.; 1 female (MTAS/Oec: 0805), 1 male (MTAS/Oec: 0806), Şahanlık Hill, Huzurlu Plateau, İslahiye District, 14.VI.2008, E.A. Yağmur & E. Tezcan leg.; **Hatay Province.** 1 juvenile, Çakıryiğit Village, Reyhanlı District (36°15'45.31"N, 36°36'24.83"E), 14.IV.2007, E.A. Yağmur, G. Çalışır & M. Yalçın leg.; 2 females, 3 juveniles, Kıcı Village, Belen District (36°29'3.92"N, 36°16'6.84"E), 13.VII.2007, E.A. Yağmur & G. Çalışır leg.; 2 subadult females, Aktepe Town, Hassa District (36°41'55.55"N, 36°29'58.83"E), 05.V.2008, E.A. Yağmur, G. Çalışır, E. Ulupınar & V. Ülgezer leg.; 2 females, 1 subadult male, Belen Pass, 10.V.2008, E.A. Yağmur, G. Çalışır & E. Ulupınar leg. **Kahramanmaraş Province.** 1 subadult male, Başkonuş Plateau (37°34'6.55"N, 36°35'4.94"E), 21.VI.2007, E.A. Yağmur & G. Çalışır leg.; 1 juvenile, Narlı Town, Pazarcık District, 07.III.2008, E.A. Yağmur & G. Çalışır leg.; 2 subadult males, Büyükkızılcık Town, Göksun District (38°12'1.54"N, 36°42'17.83"E), 30.V.2008, E.A. Yağmur & M.S. Kılıç leg. **Malatya Province.** 1 male, Reşadiye Village, Doğanşehir District, 03.V.2008, E.A. Yağmur & E. Tezcan leg. **Osmaniye Province,** Hasanbeyli District, Kuşçubeli Pass (37°07'39.21"N,

36°33'31.58"E), 24.IV.2008, E.A. Yağmur & E. Tezcan leg. **Siirt Province.** 1 female, Baykan District (38°03'08"N, 41°46'50"E), 18.V.2009, E.A. Yağmur & M. Uslu leg. **Şanlıurfa Province.** 1 male, Harran Ruins, Harran (36°52'12.08"N; 39°01'51.47"E), 12.V.2004, R.S. Kaya leg.; 1 female, Karaca Hamlet, Karahisar Village (37°03'48.72"N; 39°15'45.12"E), 09.V.2006, E.A. Yağmur & M.Z. Yıldız leg.; 1 female, 1 juvenile, Aşağı Göklü Village, Halfeti District (37°19'35"N; 38°02'4"E), 21.XII.2007, E.A. Yağmur leg.; 3 juveniles, Siverek District, a bridge about 20 km south of Siverek, 11.IV.2008, E.A. Yağmur, G. Çalışır & M. Özkörük leg.

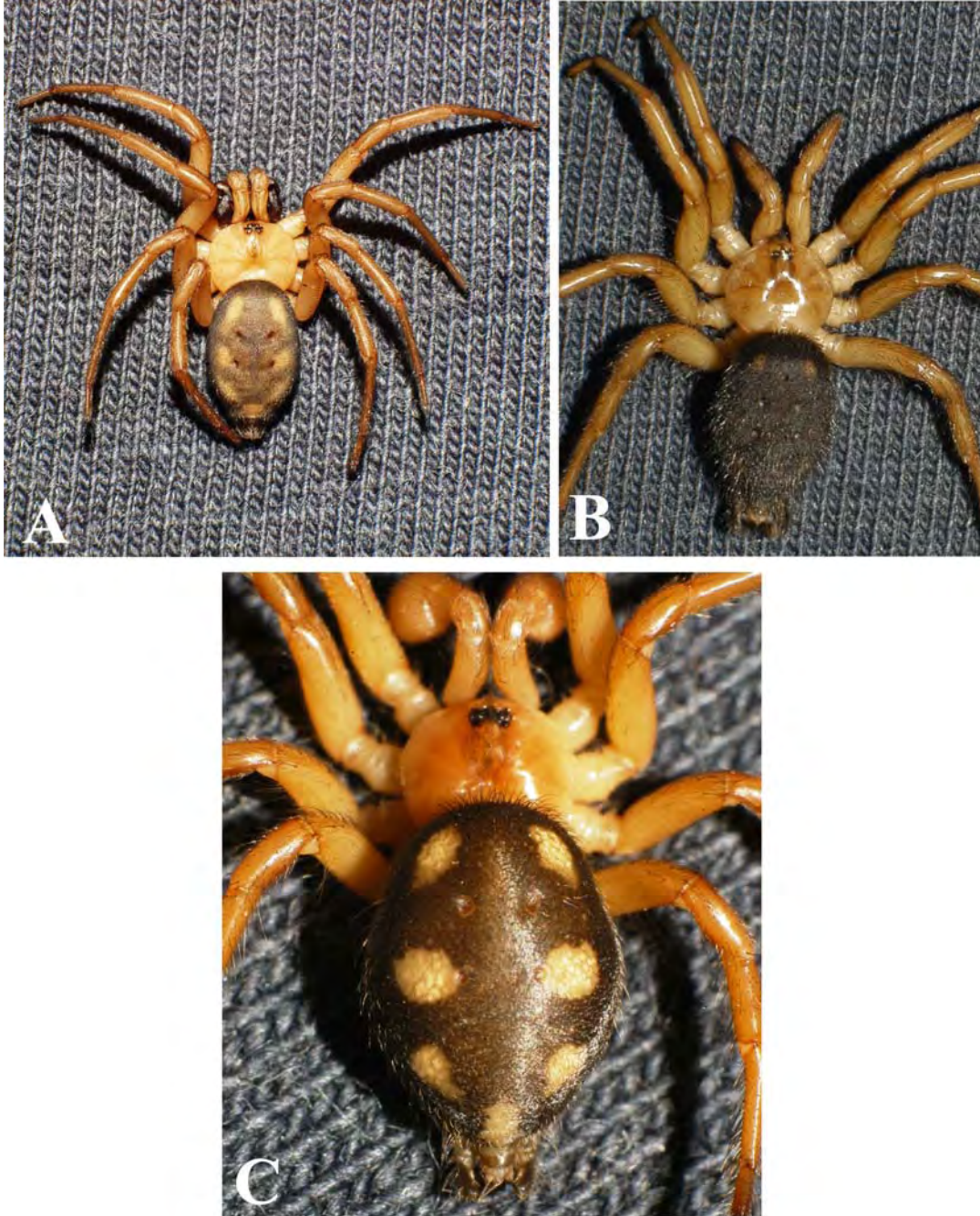


Fig. 3: Abdominal patterns of *Uroctea thaleri* Rheims, Santos & van Harten, 2007 from Turkey. A. Male. B. Female. C. Subadult male.

Comments: According to Rheims *et al.* (2007), "The males of *Uroctea thaleri* can be distinguished from other species of the genus by the extremely wide tegular apophysis 1 and by the long and apically rounded proximal tegular lobe. Females can be distinguished by the long and parallel insemination and fertilization ducts, both describing a median loop between the epigynal plate and the spermathecae. An additional diagnostic character is a blind ending duct emerging basally from the fertilization ducts."

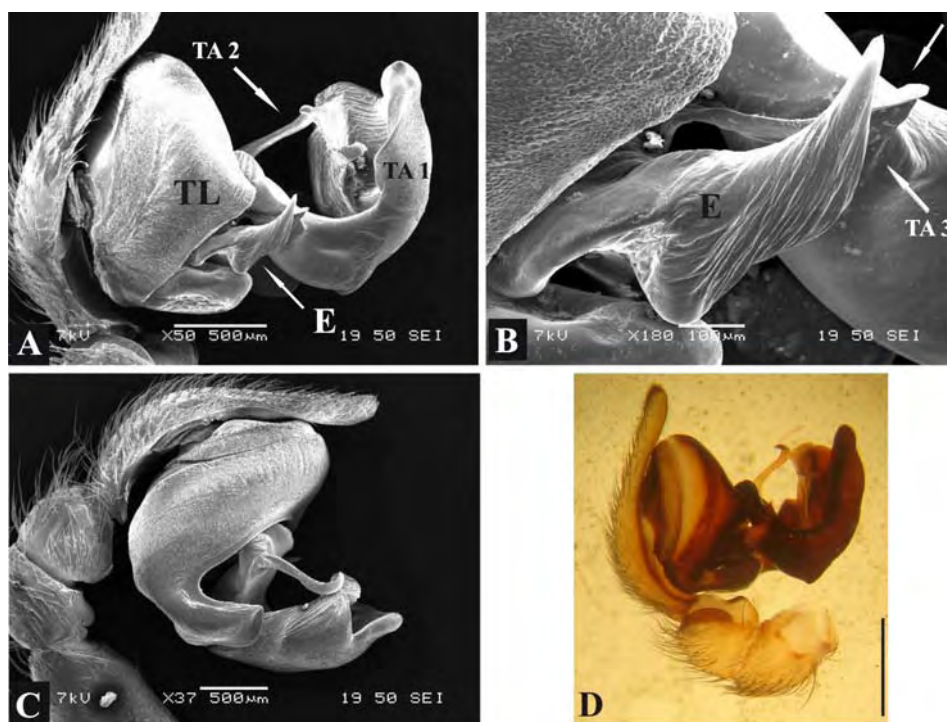


Fig. 4: Male palp of *U. thaleri* (MTAS/Oec: 0806). A, D. Left palp, prolateral view. B. Embolus C. Right palp, prolateral view. A-C: SEM. (D, Scale line = 0.5 mm). Abbreviations: E = embolus; TA1–3 = tegular apophyses; TL = tegular lobe.

Unfortunately, despite of our efforts, we could not examine the type specimens of *U. thaleri* to make comparison between them and our samples. After examining the illustrations of the type specimens of *U. thaleri* presented by Rheims *et al.* (2007, Figs. 5-8, 11-12), there is no doubt that our *Uroctea* samples collected from East Mediterranean and South East Anatolian region belong to *U. thaleri*. Their abdomens are dorsally dark grey with creamy spots or marks (Fig. 3) and they have the same genitalia of male (Fig. 4) and female (Fig. 5).

U. thaleri was described by Rheims *et al.* (2007) from Yemen. However, it has also been recorded from India, Iran and Israel. In fact, it is not unexpected to find *U. thaleri* in Turkey, taking in consideration its known distribution range. However, the record of *U. thaleri* from Israel and the seven creamy abdominal spots of juvenile Turkish samples (Fig. 3C) led us to ask a question: Do our *U. thaleri* specimens belong to *U. septempunctata* species which description was based on juvenile specimens by O.P.-Cambridge (1872) from Palestine and Syria (Lebanon)?

In 1872, O.P.-Cambridge described *U. septempunctata* as follows: "This species is similar to *C. limbata* in form and structure [Fig. 6A, B]. The whole of the fore part of the spider is yellow, but of a clearer, brighter hue than in that species; the abdomen is dull black, but the upperside, instead of being surrounded by a continuous border of a whitish-yellow colour, has in its place a marginal row of seven large yellow spots; four of these

form nearly a square on its fore half, and the three others are in a triangle above the spinners, the apex directed backwards [Fig. 6C]. It is possible that in some examples these spots may become nearly confluent, and so form a band very similar to that on the abdomen of *C. limbata*; but still some other specific characters, such as a slight difference in the relative position of the eyes, and the less dense armature of the legs with hairs, bristles, and fine spines, seem to show that it is quite distinct from that species, of which six adult examples found in 1864 at Alexandria (Egypt) presented no variation whatever in the uniformity and continuity of the abdominal border.

An immature male was found at Jerusalem under a piece of detached rock in the valley of Hinnom, an immature female in a similar situation near Ain Ata, and another at Tiberias.”

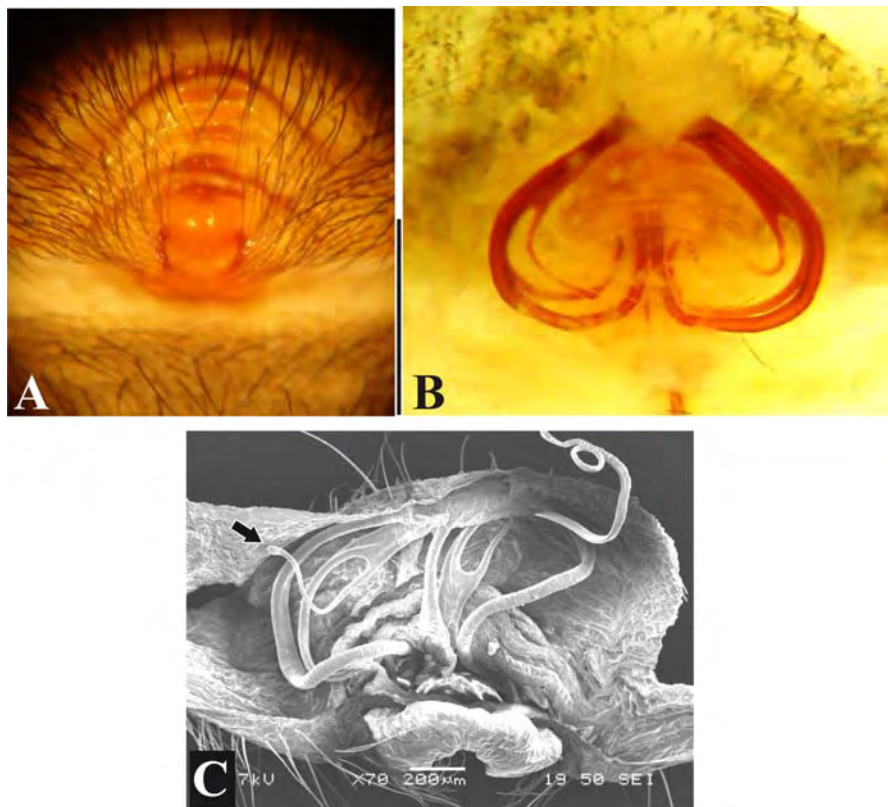


Fig. 5: Epigyne of *U. thaleri* (MTAS/Oec: 0805). A. Ventral view. B. Internal genitalia, dorsal view. (Scale line = 0.5 mm). C. Ditto, SEM, arrow shows blind ending duct.

After O.P.-Cambridge’s description, the Italian arachnologist Pietro Pavesi (1895) published a short description, without genitalia illustrations, based on an adult female collected from Hermon Mountain in Palestine/Israel. Pavesi (1895) mentioned that his adult female specimen is deposited in “Museo di Zoologia e Anatomia Comparata”, but we learned that the invertebrate collection of this museum was moved to “Museo Regionale di Scienze Naturali, Torino” many years ago. Unfortunately, we could not get a response to our correspondence with the Museum of Torino.

Comparing our *U. thaleri* specimens with a type specimen of *U. septempunctata* (OUMNH) and the Holotype of *U. limbata* (C.L. Koch, 1843) (ZMB), we observed that our Turkish samples of *U. thaleri* are similar to the first species. Especially, the abdominal pattern with seven spots of juvenile *U. thaleri* and *U. septempunctata* samples

(Fig. 3C, 6C). Also, arrangement of the eyes and position of the spines and hairs on the legs are similar in these two species.

As a result, we suggest that *U. thaleri* and *U. septempunctata* may be the same species. We could not obtain a new comparison material of *U. septempunctata* from Israel to be able to reach to definite result. But, we believe that our suggestions and findings will make some contribution to revisional studies and resolve some taxonomical problems of this genus in the future.

Natural History: The habitat selection and web designs are similar to that of *U. durandi*. They run very quickly when disturbed.



Fig. 6: *Uroctea limbata* (C.L. Koch, 1843) Male, Holotype ZMB 2121: A. Habitus, dorsal view. B. Male palp, prolateral view.

Uroctea septempunctata (O.P.-Cambridge, 1872) OUMNH 506-4671. C. Habitus of juvenile female, dorsal view. Scale lines: A, C = 1 mm; B = 0.5 mm.

Acknowledgments

We would like to thank the following colleagues who kindly provided us with the type material: Dr. Christine Rollard (Paris, France), Dr. Zoe Simmons (Oxford, U.K.), Dr. Jason Dunlop (Berlin, Germany) and Mrs. Janet Beccaloni (London, U.K.). Dr. Peter Jäger (Frankfurt am Main, Germany), Marco Isaia (Torino, Italy) and Dr. Paul Selden (Manchester, England) provided old literature. For SEM photographs, we used facilities of Department of Chemical Engineering, University of Gazi, Ankara (Dr. Metin Gürü and Dr. Çetin Çakanyıldırım). We want to express our thanks to Mr. Hisham El-Hennawy (Cairo, Egypt) and Dr. Adalberto J. Santos (Minas Gerais, Brazil) for their valuable comments. We also thank Mr. Kağan Bozkurt (Isparta, Turkey), Mr. Mert Elverici (Ankara, Turkey) and Mr. Can Elverici (Ankara, Turkey) for providing material of *U. durandi* which collected from different regions of Turkey. Finally, we like to thank Dr. Sinan Anlaş (İzmir, Turkey), Gökhan Çalışır (Gaziantep, Turkey), Erman Tezcan (Gaziantep, Turkey), Mehmet Özkörük (Gaziantep, Turkey), Mustafa Pehlivan (Gaziantep, Turkey), Mehmet Yalçın (Hatay, Turkey), Ekber Ulupınar (İstanbul, Turkey), Volkan Ülgezer (İstanbul, Turkey), Mehmet Sait Kılıç (Gaziantep, Turkey), Mustafa Uslu (Siirt, Turkey) for their valuable help during our field trips.

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***Kochiura aulica* (C. L. Koch, 1838) (Araneida: Theridiidae) against greenhouse pests**

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Abstract

Mass rearing of *Kochiura aulica* (C.L. Koch, 1838) (Arachnida: Araneida: Theridiidae) was achieved during two years, 2005-2007, using 200 containers, each contained 150-200 individuals. Egg sacs were collected from every container for four months after maturity. Number of egg sacs during mass rearing period was 55851 egg sacs, yielded 289217 individuals during four months.

Spiders release was carried out on 22 October 2006. The experiments were conducted in a greenhouse planted with cucumber variety (Gioagosrz) on 9 October 2006 in two levels, 5 and 10 spiderlings/plant, and was left without pesticides. The percent reduction in population density of *Bemesia tabaci* increased gradually reaching its maximum 67.93 and 74.65% in level 1 and level 2 respectively after two months of release. After two months of release, the percentage reduction of *Aphis gossypii* was 68.83 and 85.23% in level 1 and level 2, respectively. After two weeks from releasing the predator, we were obligated to use the biocide (Mospilan) to decrease the population density of aphids after studying its toxicity on the predator under laboratory conditions. The percent reduction of *Polyphagotarsonemus latus* increased gradually after two months of release to reach 69.38 and 70.02% in level 1 and level 2, respectively. Redomel plus 50%W.P. was used as fungicides inside greenhouse.

These experiments denote that *Kochiura aulica* can be used in biological control of insect pests inside greenhouses.

Keywords: *Kochiura aulica*, Theridiidae, Spiders, Mass rearing, Spiders release, Biological control.

* This article is a part of the Ph.D. Thesis of the first author (NA).

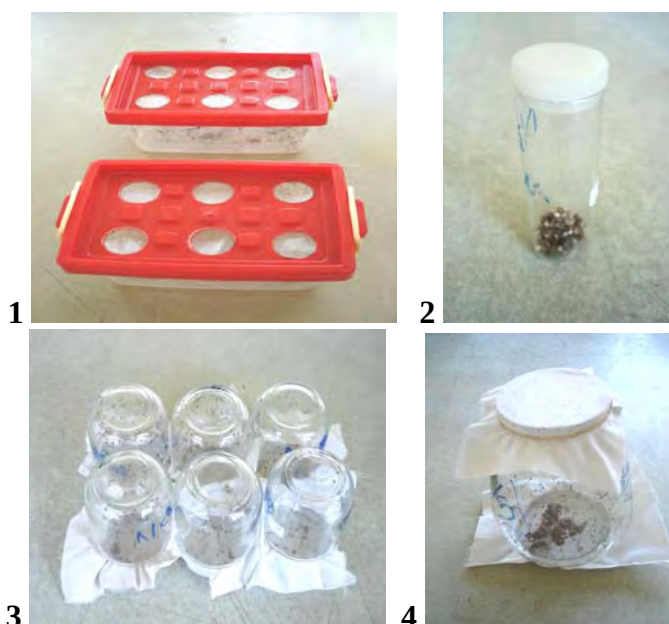
Introduction

Spiders, as predators, play an important role in agroecosystems. They are considered biocontrol agents against economic pests of various agricultural crops. Among the 109 families of spiders, Theridiidae is the fourth among six families which number of species exceeds 2000. Family Theridiidae includes 2295 species of 109 genera (Platnick, 2009). The theridiid spider *Kochiura aulica* is considered one of quasi-social species. Its mass rearing was studied by Abdel-Karim *et al.* (2006). In this paper, *K. aulica* was used as insect pest predator, i.e. a biological control agent.

Material and methods

I. Mass rearing of *Kochiura aulica* (C.L. Koch, 1838)

The stock culture of *K. aulica* was collected from olive trees located in Giza governorate by collecting many spider nests containing a mixture of spiderlings, adults and egg sacs and to be reared in the laboratory according to Abdel-Karim *et al.* (2006). About 150-200 adult individuals of *K. aulica*, at the ratio of 2♀: 1♂, were transferred to 2 litre rectangular plastic container as rearing unit (Fig. 1). The central part of the container's cover was replaced by organza textile to facilitate ventilation. The 200 rearing units were supplied thrice a week by the adult stage of fruit flies, *Drosophila melanogaster* Meigen, 1830 (Diptera: Drosophilidae) adults. Egg sacs were collected, using a fine soft brush, from the stock culture before feeding mothers and were transferred to glass tubes, of 5 cm diameter and 10 cm height (Fig. 2), until hatching. The newly hatched spiderlings were counted and each 50 individuals were transferred to a small glass container (about 250 cc) covered by muslin or organza (Fig. 3) and fed on adult fruit flies. As the new hatch reached the third spiderling instar, the contents of each 3-4 glass containers were transferred to a larger glass container (7 cm diameter and 20 cm height) covered by muslin or organza (Fig. 4) and were fed in the same way until reaching adulthood. Adults were then transferred to plastic containers for mating and egg laying. Rearing continued since July 2003 until April 2007. The regular data was noted from 2005 until 2007.



Figs. 1-4: Rearing containers. 1. Two litres rectangular plastic rearing unit. 2. Glass tube, 5 x 10 cm. 3. A small glass container, about 250 cc. 4. Glass container, 7 x 20 cm.

II. Predator release

The experiments were conducted in a greenhouse which is covered with theran. The greenhouse was divided into three divisions; two replicates and a control using transverse barriers made of theran. Each division was planted with 200 plants of cucumber, *Cucumis sativus* L., variety (Gioagosrz) on October 9, 2006 and was left without pesticides. Release was carried out on 22nd October 2006.

Releasing *K. aulica* was carried out by small bags made of paper. A ring of paper was placed inside the bag, as a pillar, before inserting spiders inside the bag. One bag was prepared for each plant. The rate of predator was 5 spiderlings/plant in the first replicate and 10 spiderlings/plant in the second replicate.

For release, we used 3rd and 4th instars spiderlings. Samples of 10 leaves were taken from each replicate as well as the control and examined in the laboratory using a stereomicroscope. The adults of white flies were examined in the greenhouse. Count was undertaken before release at weekly intervals. On 23rd November, we were obliged to spray the specific natural pesticide Mospilan mixed with Redomel plus (See p.107).

III. Toxicological studies

To study the side effect of some chemical compounds usually used for controlling pests inside the cucumber greenhouse on spiders under laboratory conditions, the following materials were used:

1. Trade name: Vertimec 1.8% EC.

Chemical name: 5-O-dimethyl Avermectin A_{1a} (i) mixture with 5-O-dimethyl-25-de (1-methylpropyl)-25-(1-methyl) Avermectin A_{1a}(ii).

2. Trade name: Lannate 90% WP.

Chemical name: methyl N-((methylamino)Carbonyl)oxy) ethanimidothioate.

3. Trade name: Mospilan 20% SP.

Chemical name: (E)-N-(6-chloro-3-Pyridinyl)methyl)-N-cyano-N-methylethanimidamide.

4. Trade name: Redomel plus 50% WP.

Chemical name: methyl N-(2,6 dimethyl phenyl)-N-(methoxyacetyl)-D-alaninate.

Small plastic Petri dishes (8 cm diameter, 1 cm depth) were used. The pesticide formulations were diluted in water to prepare the recommended dose. Two circular coffee filters (7.5 cm diameter), dipped in pesticide solution, were used for each dish, one on bottom and one above. Four replicates were used for each concentration, while in control the coffee filters were dipped in water. Five spider individuals were used for each replicate, kept in an incubator under 20°C and 75-80% RH. Mortality rate was recorded, 1, 2, 5 and 7 days, after application. Mortality values were corrected for control mortality according to Abbott's formula (1925).

Results

I. Mass rearing of *Kochiura aulica*

Two hundred containers were used in rearing spiders during two years 2005-2007. Egg sacs were collected from every container for four months after maturity. During the first month, the average number of egg sacs was 70.37±23.29 (ranged between 127 and 22 egg sacs/container) (Table 1). In the second month, the numbers of egg sacs ranged between 129 and 43. The average number of egg sacs strongly decreased during the third month to reach 75.02±20.87 egg sacs/container (ranged between 127 and 20 egg sacs/container). The average number of egg sacs during the fourth month was the least one as 43.51±16.87 egg sacs/container (ranged between 92 and 11 egg sacs/container).

Table 1. Number of egg sacs per container in mass rearing experiments during two years 2005-2007.

First month		Second month		Third month		Fourth month	
Highest number	Lowest number	Highest number	Lowest number	Highest number	Lowest number	Highest number	Lowest number
127	22	129	43	127	20	92	11
122	29	127	48	127	25	92	11
121	31	126	53	124	32	92	17
114	31	126	58	124	36	91	19
114	32	125	60	121	38	86	19
112	33	124	61	113	38	78	19
112	33	123	61	113	41	75	21
111	34	121	62	110	42	75	22
110	34	121	62	107	43	75	22
110	34	121	63	106	43	74	23
110	-	-	63	-	-	-	23
-	-	-	63	-	-	-	23
-	-	-	-	-	-	-	23

The obtained average number of egg sacs was 279.26 egg sacs/container, ranged between 450 and 179 egg sacs. The highest mean per month occurred in the second month (90.01 ± 18.99), followed by the third month (75.02 ± 20.87) while least mean occurred in the fourth month (43.51 ± 16.87). Total number of egg sacs collected from 200 containers during four months was 55851 egg sacs (Table 2).

Table 2. Average number of egg sacs in mass rearing experiments during two years 2005-2007.

	First month	Second month	Third month	Fourth month	Total
Total	14145	18001	15004	8701	55851
Average	70.73	90.01	75.02	43.51	279.26
SD.	23.29	18.99	20.87	16.87	44.76

During the first month, the average of hatching was 282.26, ranged between 509 and 90, individuals/container (Table 3). During the second month, the average of hatching increased to 562.23 (ranged between 933 and 244 individuals/container). The average rates of hatching during the third month dropped to 412.47 individuals/container (ranged between 1016 and 128 individuals/container). During the fourth month, the the average of hatching was the lowest to record 188.96 individuals/container (ranged between 524 and 9 individuals/continuer).

The hatching number per container averaged 1445.92 (ranged between 2384 and 884 individuals/container) during the four months (Table 4). The highest number occurred in the second month (562.23) followed by the third month (412.47). The lowest number occurred in the fourth month (189.13) individuals/container. Total number of hatching, collected from 200 containers during four months reached to 289217 individuals.

Table 3. Number of hatch per container in mass rearing experiments during two years 2005-2007.

First month		Second month		Third month		Fourth month	
Highest number	Lowest number	Highest number	Lowest number	Highest number	Lowest number	Highest number	Lowest number
509	90	933	244	1016	128	524	9
500	109	930	263	768	160	523	62
484	113	929	272	739	196	512	65
475	118	921	287	721	205	475	68
468	123	910	313	719	212	453	69
463	124	910	314	719	214	451	70
461	124	852	317	673	219	438	74
445	125	851	319	651	220	437	74
439	125	829	327	625	225	419	76
438	135	827	333	619	226	415	78

Table 4. Average number of hatch in mass rearing experiments during two years 2005-2007.

	First month	Second month	Third month	Fourth month	Total
Total	56452	112446	82493	37826	289217
Average	282.26	562.23	412.47	189.13	1446.09
SD.	96.29	150.90	128.33	101.86	275.54

II. Release of *Kochiura aulica* in a greenhouse of cucumber plants

A. Biological control of *Bemisia tabaci*

The release of the predator, *K. aulica*, was carried out with two levels on 22 October 2006. The rate of predator was 5 spiderlings/plant in the first replicate and 10 spiderlings/plant in the second replicate. The pre-count of population density of *Bemisia tabaci* (Gennadius, 1889) was 191, 183 and 223 as adult stage/10 leaves in level 1, level 2 and control, respectively. After one week of release of *K. aulica*, the percent reduction in population density of *B. tabaci* increased gradually to 26.54 and 28.80% in level 1 and level 2, respectively. In the same time, population density of *B. tabaci* in control increased from 223 to 267 adults/10 leaves (Table 5).

After two weeks of predator release, the reduction in population density of *B. tabaci* was 30.30 and 37.59% in level 1 and level 2, respectively. On the opposite side, pest population increased in the control reaching 330 adults/10 leaves. After two months of release, the percent reduction of the pest increased gradually reaching its maximum, 67.93 and 74.65% in level 1 and level 2, respectively. At that time, the pest population was reduced to 103 and 78 adults/10 leaves while the pest population increased in the control reaching 375 adults/10 leaves.

Table 5. Population density and reduction percentage of *Bemesia tabaci* before and after release of *Kochiura aulica* in a greenhouse of cucumber plants (variety Gioagosrz) during the season 2006.

Rate of release, spiderlings per plant (s/pl)	Pre-count	Number (No.) and reduction percent (R%) of adult stages of <i>Bemesia tabaci</i> /10 leaves							
		No.	R%	No.	R%	No.	R%	No.	R%
		29/10		5/11		12/11		19/11	
5 s/pl	191	186	26.54	197	30.30	179	30.57	233	35.54
10 s/pl	183	156	28.80	169	37.59	139	43.73	188	45.71
Control	223	267	-	330	-	301	-	422	-
		26/11		3/12		10/12		17/12	
5 s/pl		187	38.79	136	41.19	95	57.50	103	67.93
10 s/pl		123	51.49	97	56.22	68	68.25	78	74.65
Control		309	-	270	-	261	-	375	-

Table 6. Population density and reduction percentage of *Aphis gossypii* before and after release of *Kochiura aulica* in a greenhouse of cucumber plants (variety Gioagosrz) during the season 2006.

Rate of release, spiderlings per plant (s/pl)	Pre-count	Number (No.) and reduction percent (R%) of movable stages of <i>Aphis gossypii</i> /10 leaves									
		12/11		19/11		26/11	3/12	10/12		17/12	
		No.	R%	No.	R%	*	Precount	No.	R%	No.	R%
5 s/pl.	73	574	67.27	1326	82.26	*	28	20	53.85	16	68.83
10 s/pl	58	176	87.37	548	90.86	*	48	18	75.77	13	85.23
Control	36	865	-	3686	-	*	42	65	-	77	-

* = The experiment was treated with Mospilan.

B. Biological control of *Aphis gossypii*

The pre-count of population density of *A. gossypii* Glover, 1877 (Hemiptera: Aphididae) was 73, 58 and 36 movable stages/10 leaves in level 1, level 2 and control, respectively (Table 6). The percent reduction in population density of *A. gossypii* reached 67.27 and 87.37% in level 1 and level 2, respectively, after one week of releasing the predator. In the same time, the population density of the pest in control increased from 36 to 865 movable stages/10 leaves. After two weeks from releasing the predator, the reduction percentage of *A. gossypii* reached 82.26 and 90.86 movable stages/10 leaves in level 1 and level 2, respectively. In the same time, the population density of the pest increased in the control reaching 3686 movable stages/10 leaves in spite of the reduction increase, so that we were obliged to use the biocide Mospilan, mixed with Redomel plus,

to decrease the population density after studying its toxic effect on the predator under laboratory conditions.

This experiment showed that the Mospilan is completely safe for the predator. After fifth week from predator release, the population density of *A. gossypii* was 20, 18 and 65 movable stages/10 leaves in level 1, level 2 and control, respectively with percent reduction 53.85 and 75.77 in level 1 and level 2, respectively. After two months of release, the percentage reduction of *A. gossypii* was 68.83 and 85.23 in level 1 and level 2, respectively.

C. Biological control of *Polyphagotarsonemus latus*

The examined cucumber leaves collected just before releasing the predator *K. aulica* (pre-count) harboured high number of the mite *Polyphagotarsonemus latus* (Banks, 1904) movable stages, with averages 31, 30 and 20 individuals/10 leaves in level 1, level 2 and control, respectively (Table 7).

One week after release, the obtained results indicated reduction percentage in number of the target pest in all treatments, averaged 20.97 and 31.67 in level 1 and level 2 of releasing, respectively. In the same time, population density of the *P. latus* in control increased from 20 to 40 movable stages/10 leaves.

After two weeks from predator release, the reduction percentage in population density was 42.49 and 43.48 in level 1 and level 2, respectively. Then, the percent reduction of the pest increased gradually reaching 69.38 and 78.02 in level 1 and level 2, respectively after two months of release while the pest population increased in the control reaching 276 individuals/10 leaves. At the end of experiments, the predator reached 20 and 50 individuals/10 leaves in level 1 and level 2, respectively.

Table 7. Population density and reduction percentage of *Polyphagotarsonemus latus* (Banks) before and after release of *Kochiura aulica* in a greenhouse of cucumber plants (variety Gioagosrz) during the season 2006.

Rate of release, spiderlings per plant (s/pl)	Pre-count	Number (No.) and reduction percent (R%) of movable stages of <i>Polyphagotarsonemus latus</i> /10 leaves									
		19/11		26/11		3/12		10/12		17/12	
		No.	R%	No.	R%	No.	R%	No.	R%	No.	R%
5 s/pl.	31	49	20.97	41	42.49	69	50.54	106	64.38	131	69.38
10 s/pl.	30	41	31.67	39	43.48	58	57.04	76	37.61	91	78.02
Control	20	40	-	46	-	90	-	192	-	276	-

III. Toxicological studies

According to mortality and mortality percentage of *Kochiura aulica* after exposing to different concentrations of the tested pesticides, Mospilan 20% F.b. and Redomel plus 50% W.P. are non-toxic agents for this spider. On recommended dose, the mortality percentage of *K. aulica* was 0% after exposure to Mospilan 20% F.b. and Redomel plus 50% W.P., while the acaricide Vertimec 1.8% E.C. and insecticide Lannate

90% W.P. are toxic compounds agents for *K. aulica*. The mortality percentage was 100% on recommended dose after exposure to Vertimec 1.8% E.C. or to Lannate 90% W.P.

Discussion

The mass rearing method, used in this study, was not complicated and inexpensive because the fruit fly *Drosophila melanogaster* can be reared on artificial diet with high reproduction rate. *D. melanogaster* was used as a common prey in rearing many spider species (Jackson, 1974).

During this study, the spider *Kochiura aulica* was released against greenhouse pests found on cucumber plants in two levels, 5 and 10 spiderlings/plant, the second level was the best. In spite of that the reduction of the pests, *Bemesia tabaci*, *Aphis gossypii* and *Polyphagotarsonemus latus*, was approximate.

Comparing the predator *K. aulica* with other bio-agents, we must take in consideration that this predator is polyphagous. It predaes on different kinds of prey simultaneously.

The fungicide Redomel plus and the natural compound Mospilan are highly safe to the predator. Therefore, we used them to deal with the fungal diseases and aphids inside the commercial cucumber greenhouses during the release of *K. aulica*.

This study is the onset indicator to start series of experiments for applying the usage of the predator *K. aulica* which did not interpolate in releasing system against different pests in greenhouses.

This work is the first actual experience of using the predator *K. aulica* experimentally inside greenhouses. It is recommended to use it in pest management programs under Egyptian greenhouses conditions.

Acknowledgment

The authors are indebted to Col. Hisham K. El-Hennawy (Arachnid Collection of Egypt, Cairo) who provided photographs and revised an early manuscript of the work.

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Arachnida of Ain Gudeirat (Sinai), with notes on family Titanoeidae in Egypt

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Abstract

The region of Ain Gudeirat lies in the eastern side of northern Sinai, Egypt. It is almost a small oasis irrigated by a natural spring in this arid desert. During two short fieldtrips, on April and June 2004, to the region of Ain Gudeirat, 85 specimens of four arachnid orders were collected. The collected material contained 1 scorpion species, 1 sun-spider species, 1 pseudoscorpion species, and 72 spiders of 12 families. The majority of spiders belong to two families, i.e. Lycosidae (43.05%) and Titanoeidae (29.17%). The situation of family Titanoeidae in Egypt is discussed. This preliminary study is the first arachnological study of the region of Ain Gudeirat, which is proposed to be a protected area.

Keywords: Arachnida, spiders, Titanoeidae, scorpions, sun-spiders, pseudoscorpions, Ain Gudeirat, Sinai, Egypt.

Introduction

Ain El Gudeirat is in Wadi El Gudeirat near El Qusaima Village in the northeastern part of Sinai, near Egypt's eastern international borders. It is a spring issuing from Karstic limestones like other Karst springs encountered in the Eastern and Western Deserts of Egypt and in Sinai too. The spring is on the axis of a small syncline gently plunging west to outcrops of Eocene Limestone that overlie the Paleocene shales. Wadi El Gudeirat incises the Limestone formation to the contact between the two formations. Ain El Gudeirat issues from the lowermost part of the highly fractured limestones at a daily rate of 1500 m³. The springwater flows in a small channel and is used to irrigate several hundred feddans (1 feddan = 1.04 acre) of olive trees and as a source of supply for the local villagers. Ain El Gudeirat's water has a total dissolved solids content of 1440 ppm. Chemical analysis indicates that the water of this spring is of sodium chloride type. Groundwater age dating studies indicate that the age of water from Ain El Gudeirat

is 14 000 years B.P., indicating that the recharge to this spring is late Pleistocene (Idris, 1996). Its water temperature is 23.3 °C (El Ramly, 1965).

The fresh water of Ain Gudeirat converted its region of desert to a small oasis rich of plants especially *Tamarix* trees in addition to different kinds of herbs. Bedouins and their domestic animals, especially goats and dogs, are daily visitors of the area. The flora and fauna of the region is not studied yet. The available information is mostly about the neighbouring region of El Qusaima.

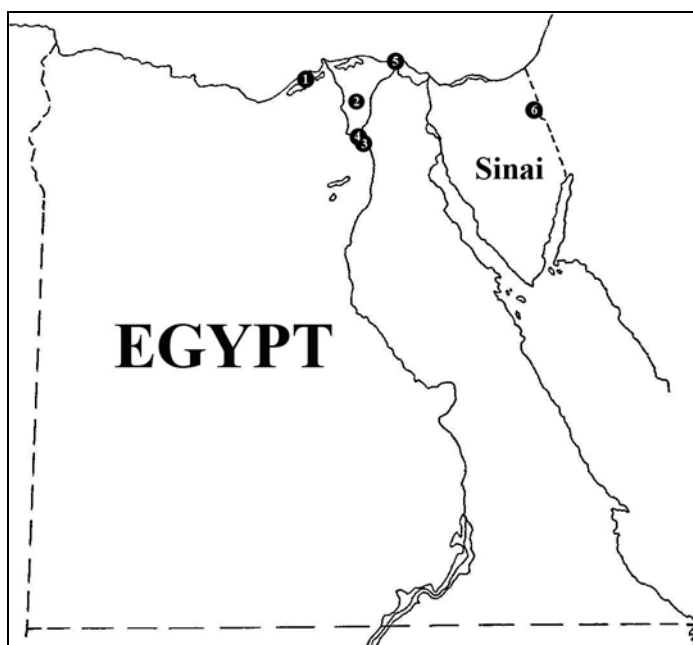
Among 21 species of five orders of mammals recorded from northern Sinai, six species were recorded from El Quseima and two species from Wadi and Ain Gudeirat, i.e. *Psammomys obesus terraesanctae* Thomas, 1902 and *Hystrix cristata* Linnaeus, 1758 of order Rodentia (Osborn & Helmy, 1980). Many bird species are present in the region, some are residents and others are migratory. Saleh (1997) recorded 8 lizard, 6 snake, and 1 toad (*Bufo viridis*) species from the region of El Quseima and its surroundings. Tadpoles were observed swimming in the water of the spring's channel on April 2004.

There are many insect species recorded from northern Sinai. Only, a few of them are recorded from Ain Gudeirat because of lack of a survey and continuous study of the region. Of course, many of these insects and other arthropods depend mainly on the spring's ecosystem.

There are plenty of dragonflies, order Odonata, flying near water surface. Several species of wasps, order Hymenoptera, and flies, order Diptera, were also observed in the region. The North African ant *Messor rufotestaceus* (Foerster, 1850) was recorded from El Quseima (Taylor & Sharaf, 2009).

Abdel-Dayem (2004) studied the diversity of carabid beetles in the Sinai peninsula and identified "Wadi Godirate" as one of the most seven specious sites in Sinai. He recorded 18 species of 10 genera from this moderately elevated site that is having a fresh water habitat. One of those species was thermophilous, found under stones, while the other species were hygrophilous, found at fresh water edges.

A few crabs, Crustacea, order Decapoda, were observed inside water channel and at its edges.



Map 1. Distribution of *Nurscia albomaculata* (Lucas, 1846) in Egypt. 1. Alexandria. 2. Shebin El-Kom. 3. Giza (Cairo). 4. Al-Kanater. 5. Ras El-Barr. 6. Ain Gudeirat.

Methods

The region of Ain Gudeirat (30°38'59.8"N, 34°26'13.7"E, Alt. 404 m) lies in the eastern side of northern Sinai, Egypt (Map 1). During two short fieldtrips, for a few hours, on 24 April and 3 June 2004, 85 specimens of four arachnid orders were collected, looking on plants and under stones, using light trap and UV radiation at night. [Abbreviations: TL = total length, L = length, W = width]. All measurements are in mm.

Results and Discussion

The collected material included 85 specimens of four orders: 1 scorpion, 10 sunspiders, 2 pseudoscorpions, and 72 spiders of 12 families.

I. Order Scorpionida

Only 1 scorpion of *Leiurus quinquestriatus* (Ehrenberg, 1828), Family Buthidae, was collected in June 2004, after sunset, using UV.

II. Order Solpugida

Ten males of *Biton ehrenbergi* Karsch, 1880 (Family Daesiidae) were collected; 1 under stone, and 6 attracted to light after sunset, in April + 3 attracted to light about 75 minutes after sunset, in June 2004.

III. Order Pseudoscorpionida

Two specimens, 1♂ and 1j, of *Minniza* sp., Family Olpiidae, were found under stones in June 2004.

IV. Order Araneida

The total of 72 spiders of 12 families were found on plants and under stones. The majority of spiders belong to two families, i.e. Lycosidae (43.05%) and Titanoecidae (29.17%) (Table 1).

Table 1. Spiders collected from Ain Gudeirat.

Family	24 April 2004	3 June 2004	%
Araneidae	1♀	---	1.388
Dictynidae	1♀	---	1.388
Filistatidae	---	1j	1.388
Gnaphosidae	---	1♂; 1♀	2.777
Linyphiidae	1♀, 1s♀	1♀	4.166
Lycosidae (6 species)	1♀ <i>Arctosa cinerea</i> ?; 1♀ <i>Hogna ferox</i> ; 4♂, 15♀, 2s♂, 2j	2♀, 1j <i>Arctosa cinerea</i> ?; 1♂ <i>Wadicosa</i> ?; 1s♂, 1j	43.05
Oecobiidae	1s♀ <i>Oecobius putus</i> ?	---	1.388
Pholcidae	1♀	---	1.388
Salticidae	1♀	1♂ <i>Menemerus animatus</i> ?	2.777
Sicariidae	1j <i>Loxosceles</i> sp.	3j <i>Loxosceles</i> sp.	5.555
Tetragnathidae	2j <i>Tetragnatha</i> sp. ?	1s♂, 1s♀ <i>Tetragnatha</i> sp. ?	5.555
Titanoecidae	3♂, 8♀, 2s♂, 1s♀, 1j <i>Nurscia albomaculata</i>	1♂, 4♀, 1j <i>Nurscia albomaculata</i>	29.17
Total	50 spiders	22 spiders	

El-Hennawy (2002a) recorded 7 families of spiders from 'Ain Jodairat (misspelling), depending on juvenile specimens collected in 1996 by Dr. Orabi; Filistatidae, Gnaphosidae, Lycosidae, Sicariidae (*Loxosceles* sp.), Theridiidae, Titanoecidae, and Zodariidae. Theridiidae and Zodariidae are wanting this time.

Nurscia albomaculata (Lucas, 1846), family Titanoecidae, was the most dominant species in the area after lycosid spiders. The flimsy webs of these cribellate spiders were found under stones and among low herbs near and over water. The pholcid spider was found in her web in a stone cavity. Other spiders were found under stones, in their webs, and moving on the ground or running on water surface. Seven lycosid females were carrying their egg sacs.

N. albomaculata was not recorded before from northern or southern Sinai (El-Hennawy, 2003, 2005). It was found in nature and inside green houses too. It lives inside its snare attached to plants stems on humid ground. It evidently prefers humid places. Therefore, it was not expected in desert. It is very interesting to find this species in the region of Ain Gudeirat's spring.

Beside the 26 protected areas in Egypt, the region of El Quseima and Ain Gudeirat is proposed as a future protected area. The decision makers usually look for big animals, for vertebrates and neglect other groups, especially "insects" (= including all arthropods). However, the region of Ain Gudeirat deserves study before protection.

Family Titanoecidae in Egypt

Family Titanoecidae Lehtinen 1967 is a small family of 44 species in 5 genera (Platnick, 2009). Its species are "widely distributed in Arctic as well as tropical regions (Indian Ocean Coast in Africa, not in Australia or New Zealand) but tend to be more common in the Northern Hemisphere" (Jocqué & Dippenaar-Schoeman, 2006).

Rock Weavers (Titanoecidae) are small to medium-sized araneomorph spiders. Their diagnostic characters are: three tarsal claws; cribellate; entelegyne; eight eyes; calamistrum long, uniseriate; endites parallel; male palpal tibia complex, with pro- and retrolateral apophyses (Jocqué & Dippenaar-Schoeman, 2006). The type genus of the family is *Titanoeca* Thorell, 1870.

Only two species of two genera of Family Titanoecidae Lehtinen, 1967 are recorded from Egypt until now (El-Hennawy, 2006). They are *Nurscia albomaculata* (Lucas, 1846) from Alexandria and Cairo (Giza) and *Titanoeca tristis* L. Koch, 1872 without known distribution in Egypt.

L. Koch (1875) described *Amaurobius tristis* as a new species from Anseba river's bank. Anseba River (Tigrinya) is now in Eritrea. This species was transferred to *Titanoeca* in Roewer's Katalog der Araneae (1954). Its distribution was "South Europe, Russia, and Egypt"! Possibly because of the title of the book?! El-Hennawy (1990, 2002b, 2006) recorded *T. tristis* from Egypt according to Roewer (1954). Wunderlich (1995) exclaimed when he discussed the distribution of *Titanoeca tristis* "Ägypten?". Indeed, *Amaurobius tristis* is recorded from Eritrea (not Ethiopia), but not Egypt (Platnick, 2009). Its systematic position may be doubtful. Lehtinen (1967: 271) stated that "*Amaurobius tristis* L. Koch 1875 (♀ type preservation unknown - from Ethiopia) was erroneously synonymized with *T. tristis* L. Koch 1872 by ROEWER (1954a). *A. tristis* L. Koch 1875 really seems to be a true *Titanoeca* but no new-name is here proposed, as its status remains obscure."

The second species is *Nurscia albomaculata* (Lucas, 1846). Genus *Nurscia* Simon, 1874 includes 4 species recorded from Portugal to France, Bulgaria, Cyprus to Central Asia, Russia, China, Korea, Taiwan, and Japan (Platnick, 2009). It was

transferred from the Amaurobiidae by Lehtinen (1967: 253). *N. albomaculata* is one of four species of genus *Nurscia* Simon, 1874. The world distribution of *N. albomaculata* is from Europe to Central Asia (Platnick, 2009).

A good summary of the diagnostic characters and figures of *N. albomaculata* is present in Nentwig, *et al.* (2003) and the most recent work dealt with it is that of Trotta (2005).

***Nurscia albomaculata* (Lucas, 1846)**

Synonyms (Platnick, 2009):

Epeira albo-maculata Lucas, 1846: 250, pl. 15, f. 6 (D♀).

Singa albo-maculata Simon, 1864: 256.

Amaurobius 12-maculatus Canestrini, 1868: 204 (D♂).

Amaurobius distinctus O. P.-Cambridge, 1872a: 263 (D♂♀).

Titanoeca albomaculata Simon, 1874a: 218, pl. 3, f. 7 (♂♀).

Titanoeca distincta O. P.-Cambridge, 1876: 557. *

Amaurobius albomaculatus Canestrini, 1876: 213.

Nurscia albomaculata Lehtinen, 1967: 253 (T♂♀ from *Titanoeca*).

* The record of O. P.-Cambridge of this species from Egypt (1876) was not included in Roewer's Katalog der Araneae (1954) or in "The World Spider Catalog" (Platnick, 2009).

O. P.-Cambridge (1876: 557) recorded *Titanoeca distincta*, of family Agelenides, from Egypt saying, "Adults and immature examples of this Spider were found among the dead stems and débris of bushes and under stones near Alexandria in April 1864. In the same month of the year following I met with it more abundantly under stones and fragments of rock and among débris on the plains of the Jordan". He made both *Amaurobius distinctus* Cambridge, 1872 and *Titanoeca albomaculata* Simon, 1874 synonyms to his *Titanoeca distincta*.

O. P.-Cambridge (1872: 263-264) described *Amaurobius distinctus* as follows:

Amaurobius distinctus, sp. nov.

Male adult, length $2\frac{3}{4}$ lines [= 5.82 mm]; female adult $3\frac{1}{4}$ [= 6.88 mm].

This remarkably distinct species, although closely allied to *A. simplex*, may be at once distinguished by two longitudinal rows of pure white spots on the upperside of the abdomen; the ground-colour of which is jet-black; these rows consist each of 5-6 spots, and they converge towards each other a little as they approach the spinners; the four foremost of the spots are the largest and occupy the fore half of the upperside of the abdomen, forming a large and nearly square area; the spots which succeed are smaller, and diminish gradually in size towards the spinners. The *cephalothorax* is of a dull yellow-brown colour, narrowly margined with black. The *eyes* are very similarly situated to those of *A. simplex*, but those of the lateral pairs are rather nearer to each other. The *legs* are moderately long and strong, and are furnished with hairs and a few spines, of which latter the chief consist of a row beneath the metatarsi of the first pair, short and tooth-like; the colour of the legs is a dull brownish yellow deepening at the extremities of the joints, and thus giving them a kind of indistinctly annulate look. The *falces* [chelicerae] are rather long, strong, similar to the cephalothorax in colour, slightly hollowed on their inner sides, and impressed near their extremities in front. The males of this species have a supernumerary spinning-organ but no calamistra; the females have both.

The *palpi* are short, strong, and similar in colour to the *legs*; the radial joint has some strong irregular prominences at its fore extremity; and the digital, which is large and of a

somewhat oblong-oval form, has a strong, rather angular, sharp-pointed prominence at its base on the outer side; the palpal organs are highly developed and prominent, having some large and variously formed corneous processes connected with them.

Several examples of both sexes, but the males immature, were found beneath stones and among débris of various kinds on the plains of the Jordan. In similar situations I also found examples of both sexes, both adult and immature, at Alexandria (Egypt) in 1864.

The description of O. P.-Cambridge (1872) is adequate for identification. Furthermore, eyes have almost the same diameter. Leg formula I-IV-II-III. The TL of males and females of *Nurscia albomaculata* from the region of Ain Gudeirat are: Males 5.30 - 6.30 mm (5.68 ± 0.54), Females 5.17 - 7.10 mm (6.29 ± 0.665). Body measurements of male (Fig. 1): TL 6.30, Cephalothorax L 2.91, Thoracic part W 2.01, Abdomen L 3.45, and female (Fig. 2): TL 7.10, Cephalothorax L 2.81, Thoracic part W 1.96, Abdomen L 4.35. Legs measurements of male and female (Table 2). Male's palpal organ (Figs. 3, 6) and female's cribellum (Fig. 4) and epigynum (Fig. 5).



Figs. 1-6. *Nurscia albomaculata* (Lucas, 1846). 1, 3, 6. Male. 2, 4, 5. Female. 1, 2. Habitus, dorsal view. 3, 6. Palp, prolateral and retrolateral views. 4. Abdomen, ventral view (Arrow → cribellum). 5. Epigynum, ventral view.

Table 2. Legs measurements of *Nurisia albomaculata* male and female.

Leg	Male				Female			
	I	II	III	IV	I	II	III	IV
Femur	2.65	2.23	1.85	2.65	2.38	2.01	1.54	1.80
Patella	1.48	0.79	0.53	0.90	1.01	0.90	0.79	0.85
Tibia	2.65	1.85	1.75	2.17	1.70	1.38	1.17	1.59
Metatarsus	2.39	1.85	1.59	1.96	1.70	1.32	1.22	1.59
Tarsus	1.01	0.95	0.79	0.85	0.85	0.69	0.69	0.69
Total length	10.18	7.67	6.51	8.53	7.64	6.30	5.41	6.52

Records and Distribution of *Nurisia albomaculata* in Egypt

Nurisia albomaculata was recorded from (Fig. 1):

1. Alexandria [31°12'51"N, 29°56'46"E]:

Amaurobius distinctus O.P.-Cambridge, 1872: 264.

Titanoeca distincta O.P.-Cambridge, 1876: 557.

Titanoeca albomaculata (= *Amaurobius distinctus*) Simon, 1880: 48.

Amaurobius (Titanoeca) albomaculata Simon, 1910: 276. Egypt.

2. Shebin El-Kom, Menoufiya Governorate (Ghabbour, *et al.*, 1999)¹. [30°33'17"N, 31°00'32"E]

3. Dokki, Giza (Cairo) (Sallam & El-Hennawy, 2003). [30°01'20"N, 31°12'18"E]

4. Al-Kanater Agricultural Research Station, El-Qalyubia governorate (Zaher *et al.*, 2005)². [30°11'39"N, 31°07'54"E]

5. Ras El-Barr, at the Mediterranean coast (New locality). [31°29'58"N, 31°48'30"E]

6. Ain Gudeirat, northern Sinai (New locality). [30°38'59.8"N, 34°26'13.7"E, Alt. 404 m]

¹ Among 2170 spiders belonging to 12 families collected by pitfall traps, only 1 ♂ *Titanoecidae* was found within Cucurbits (Cucurbitaceae) fields in Menoufiya Governorate (Ghabbour, *et al.*, 1999).

² During one-year survey on spiders inhabiting fields of nine vegetable crops of two families (Leguminosae and Cucurbitaceae) using pitfall traps at Al-Kanater Agricultural Research Station, El-Qalyubia governorate, *Nurisia* spiders were collected on April-June 2001 from the fields of summer cucumber and squash (Zaher *et al.*, 2005).

Natural history

The life style of *Titanoecidae* was summarized by Jocqué & Dippenaar-Schoeman (2006) as "Ground-dwelling spiders, making flimsy webs under stones or cribellate space webs". The same authors described the "natural history" of the family as follows: "*Titanoeca* spp. construct webs that occasionally include one or more pseudo-orbwebs (Shear, 1986). Members of the genus are usually found in dry rocky areas where they spin flimsy webs under stones and rocks. According to Szlep (1966), *Titanoeca albomaculata* Lucas is found during the day under stones, concealed in a silk retreat. In front of the retreat, a capture-web is attached to low vegetation and stones. The capture-web is compound, consisting of a number of partial webs surrounding the retreat entrance, and may be built in one or more planes and, depending on the substrate, one above the other. This type of web is intermediate between irregular webs and orbwebs. The shape of the web is variable and hackled bands may be present, reminiscent of webs of cribellate orb-weavers" (Dippenaar-Schoeman & Jocqué, 1997).

The web spinning of *Titanoeca albomaculata* was first studied by Szlep (1966). Shear (1986) discussed the "pseudo-orbs" of *Titanoeca albomaculata*, saying, "The web

of *Titanoeca albomaculata* is spun near the ground, and the spider has a retreat under a rock. No frame threads are spun, and radii are constructed in any particular order; some may be laid during the spinning of the cribellate thread. The cribellate thread appears nearly continuous and is laid across the whole range of radii, the spider turning back at the last radius in each series, and, according to Szlep (1966), the measuring activities of the spider resemble those of the orb-weaving uloborids. Additional elements, including sectors and semicircles, may be added later, so that there appear to be several "hubs" in the same web." Eberhard (2000) added "*Titanoeca albomaculata* makes webs resembling sections of orbs ... *Titanoeca*, non-orb weaving species that make geometrically highly organized and stereotyped webs that have semi-independent subunits (Szlep 1966)".

The life cycle of *Nurscia albomaculata* in laboratory was studied by Sallam & El-Hennawy (2003). It had 5-6 spiderling instars before adulthood for both males and females. It continued for about 109 days. Different instars were reared on different stages of larvae of cotton leaf worm *Spodoptera littoralis* (Boisduval, 1833). Adult females lived longer than males; nearly twice (about 144 against 70 days). Life span of females was also longer than that of males (about 244 against 182 days). Males died between October and March while females died between December and April. The studied individuals were found inside their silk tunnels among plants near the connections of the roots with the stems, immediately on soil surface, and under clusters of clay which cover the roots of the plants inside greenhouses of pepper (*Capsicum annum*) in Dokki, Giza. It was the dominant ground spider species in greenhouses. The authors noted cannibalism among adults and that *N.a.* may tolerate a wide range of temperature in nature.

Acknowledgments

I wish to thank my friends and colleagues: Dr. Ashraf El-Torkey (PPRI, Cairo) who made the transportation of our team to Ain Gudeirat possible; Prof. Hassan H. Fadl, Dr. Haitham Badrawi, Mr. Ayman Mahmoud (Ain Shams University), and Dr. Mahmoud S. Abd El-Dayem (Cairo University) who helped me during the two field trips to Ain Gudeirat; Dr. Gamal Orabi (Suez Canal University) who made his spider collection of 1996 from Ain Gudeirat available to me.

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Serket (2009) vol. 11(3/4): 119-128.

Scorpions of Saudi Arabia **(List of species, their distribution, and identification key)**

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Abstract

This paper presents an updated list of scorpions recorded in the Kingdom of Saudi Arabia, the distribution localities of the species, and simplified identification keys to families and genera. The list includes 23 species and 3 subspecies that belong to 3 families: 18 species of 10 buthid genera, 1 hemiscorpiid species, and 4 species and 3 subspecies of 3 scorpionid genera.

Keywords: Scorpions, Saudi Arabia.

Introduction

Scorpions of Saudi Arabia are not adequately studied yet. The first comprehensive work dealt with them was that of Vachon (1979) who provided a taxonomic study of 14 species and subspecies. Previous and successive infrequent works included the works of Kinzelbach (1985), Vachon & Kinzelbach (1987), and El-Hennawy (1992) who reviewed the scorpion species in the Middle East and the Arab countries. Hendrixson (2006) discussed the taxonomy and species composition of the buthid scorpion fauna in the Kingdom of Saudi Arabia, with notes on two other families. He reviewed the old and recent literature and provided identification keys to families, genera and species of all families with distribution maps of species. Recently, several contributions to the comprehensive study of the scorpion sting syndrome in Saudi Arabia and scorpion's identification appeared in the works of Al-Sadoon & Al-Farraj (2008) and Al-Asmari, *et al.* (2007, 2009a, 2009b) to survey different regions of the country, i.e. Jazan, Al-Medina Al-Munawara, Al-Baha, Hail, and Riyadh regions.

This paper is prepared to present an updated list of scorpions recorded in the Kingdom of Saudi Arabia, the distribution localities of the species, and simplified identification keys to families and genera. The list includes 23 species and 3 subspecies

that belong to 3 families: 18 species of 10 buthid genera, 1 hemiscorpiid species, and 4 species and 3 subspecies of 3 scorpionid genera.

The main references consulted for systematics and identification keys are: *Catalog of the Scorpions of the World (1758-1998)* (Fet *et al.*, 2000), and the works of Sissom (1990), El-Hennawy (1992), and Kovařík (2009). The list and distribution of species mainly depended on Vachon (1979), El-Hennawy (1992), and Hendrixson (2006), in addition to other references.

Scorpions of Saudi Arabia

Family **Buthidae** C. L. Koch, 1837

Genus **Androctonus** Ehrenberg, 1828

Androctonus bicolor Ehrenberg, 1828

A. b.; Al-Asmari, *et al.* 2009a: 106; Hail; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Androctonus crassicauda (Olivier, 1807)

Buthus australis citrina; Gough & Hirst, 1927: 4; Madina (= *Androctonus amoreuxi* (Audouin, 1825)), "misidentification" (Hendrixson, 2006: 109).

A. c.; Vachon, 1979: 31-34, figs. 1-2, 4; Riyadh; Al Khardj; Riyadh-Dammam, km 85; Wadi Awsat; Harad; Jeddah; Buraiman, Torquam, Wadi Usfahn (near Jeddah); Wadi Hanifa; Al Khubra; Jebel Shafaf; Shaira; Hawi; Khurma; Qunfidah; Medain Saleh; Rumaiya; Khashm ath Thumani; NE Nariya; S Dharan.

A. australis; Levy & Amitai, 1980: 36, 40; Jidda. (El-Hennawy, 1992; Hendrixson, 2006: 38)

A. c.; Hendrixson, 2006: 38-43, figs. 1-2, plate 1; Makkah By-pass km 91.5, 21°14'N 39°49'E, 150 m; Makkah By-pass km 126, 21°19'N 40°00'E, 300 m; Jabal Sayid, 23°49'N 40°57'E, 1000 m; Jeddah City Dump, sea level, 21°24'N 39°13'E; Wadi ar-Rika, 22°30'N 44°35'E; Hulaifa, camp near oasis, 3500 ft; Province El Khobar; Wadi Turabah, 21°N 40°E, 1350 m; station Riyadh; Khashm ath-Thumami, 27°40'N 44°55'E; 35 km NE of Nariya, 27°39'N 48°43'E; 5 km S of Dhahran, 26°15'N 50°08'E; Jabal as-Sinfa, Sawawin District, 27°57'N 35°47'E; Hatim al-Khalidi, Wadi Qatan, 18°06'N 44°07'E; "près de Shigri", 28°N 36°E; Wadi Qatan, 18°06'N 44°07'E, 1500 m; Makkah By-pass km 80, 21°15'N 39°13'E; Makkah Bypass km 118.3, 21°17'N 39°56'E; Makkah By-pass km 125, 21°19'N 40°40'E, 300 m; Jeddah, 21°25'N 39°12'E; south of Jeddah, near sea; Wadi Hamaq, Camp 2; Riyadh; Sanam; al-Hashbah; 20 km NE of Makkah; Jawf; Wadi Qatan; Dammam; Sahal rimpth, 750 m; Taif; Addar, 22°10'N 39°30'E, 150 m; Khaybar/Hail; Wadi Turabah; 5 km W of al-Mubarraz; Wildlife Research Center, ca. 30 km SE of Taif, 21°16'N 40°42'E, 1400 m; Wadi ar-Rika, 22°30'N 44°35'E; vicinity of Riyadh; Turayf, 31°44'N 38°33'E, 850 m; Makkah By-pass km 80, 21°15'N 39°43'E, 150 m; Jabal al-Ghamdiyah.

A. c.; Al-Asmari, *et al.* 2007: 833; Al-Medina Al-Munawara; Al-Asmari, *et al.* 2009a: 106; Hail; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Genus **Apistobuthus** Finnegan, 1932

Apistobuthus pterygocercus Finnegan, 1932

A. p.; Finnegan, 1932: 92; Uruq Dhahiqah, Shena.

A. p.; Vachon, 1979: 34-35, figs. 4-5; Uraq (SE Arabia); Dhahiga; Shannah; Andhur; Al Khardj; Dhahran.

A. p.; Hendrixson, 2006: 44-46, figs. 3, 6, plate 2; Safura Desert; Shawala, Camp 3.

A. p.; Al-Asmari, *et al.* 2009a: 106; Hail.

Genus **Buthacus** Birula, 1908

Buthacus buettikeri Hendrixson, 2006

B. leptochelys ssp.?; Vachon, 1979: 38-39, figs. 7-8, 26, 29, 61-63; Wadi Diriyah; Hofuf Road; Wadi Khuwa; Al Khubra; Jebel Samar.

B. b.; Hendrixson, 2006: 47-52, 59, figs. 4-6, plates 3, 4; Um ad-Dabah. Khashm Dhibi. Addar. Wadi Maraum. Jabal al-Ghamdiyah. Kijat. Makkah By-pass km 91.5.

B. leptochelys; Al-Asmari, *et al.* 2009a: 106; Hail; Al-Asmari, *et al.* 2009b: 618; Riyadh. [The identification of *B. leptochelys* may be wrong.]

Buthacus yotvatensis nigroaculeatus Levy, Amitai & Shulov, 1973

B. y. n.; Vachon, 1979: 36-38, figs. 6, 8; Dammam; Al Khardj; Dhahran; Kurais area.

B. tadmoresis n.; Kinzelbach, 1985: map III.

B. y. n.; Hendrixson, 2006: 52-56, figs. 6-7, plate 5; Rub al-Khali, 22°07'N 48°14'E; Chantier OGER International, Dammam; Riyadh; vicinity of Riyadh; Aqabat al-Uhuraytan, 27°48'N 36°04'E; ca. 80 km NW of Riyadh; Riyadh; Khashm Sudayr.

B. y. n.; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Genus **Butheolus** Simon, 1882

Butheolus anthracinus (Pocock, 1895)

B. a.; Hendrixson, 2006: 56-59, figs. 6, 8, plate 6; Khamis Mushait, 18°18'N 42°44'E.

Butheolus villosus Hendrixson, 2006

B. v.; Hendrixson, 2006: 59-61, figs. 6, 9, plate 7; Khashm Dhibi.

Genus **Compsobuthus** Vachon, 1949

Compsobuthus arabicus Levy, Amitai & Shulov, 1973

C. a.; Levy, Amitai & Shulov, 1973: 122-124, figs. 17-20; Daugha; Wadi Mughhin; Ramlat Enfel; Khor Enfel.

C. a.; Vachon, 1979: 39-40, figs. 9, 11; Daugha; Ramlat Enfel; Khor Enfel; Wadi Mughohin; SW & NW Dhahran; Quwayiyah; El Khubra, Ath Thamamah, N of Riyadh.

C. a.; Hendrixson, 2006: 62-64, figs. 10, 13; Daugha, 900 feet [near Yemen-Oman borders].

C. a.; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Compsobuthus fuscatus Hendrixson, 2006

C. weneri ssp.?; Vachon, 1979: 40-42, figs. 10-11, 58-60; Wadi Marba, Khamis Mushayt; Village Qaraah; Abha-Taif Road; Wadi Usfahn (near Jeddah).

C. f.; Hendrixson, 2006: 65-67, 74, figs. 11, 13, plate 8; Jabal Qishayradh, 21°17'N 40°17'E; al-Mashrab Sarat Abidah, nr. 18°N 43.5°E, 2000 m; Wadi Kharrar, 21°17'N 40°06'E, 460 m; Wadi al-Amar, 18°52'N 42°16'E, 2400 m; Namas, 2380 m; Jabal Sawda, 18°18'N 42°20'E, 2000 & 2800 m; Wadi Mahra, 19°38'N 42°38'E, 2000 m; Wadi Mihrim, 13 km Taif al-Had Road, 21°20'N 40°19'E, 1700 m; Wadi Sizan Dam, 17°02'N 41°55'E, 200 m; Hijla, 14 km E of Abha; Jeddah; Wadi Shuqub, Makkah Province, 20°39'N 41°13'E, 1390 m.

C. weneri; Al-Asmari, *et al.* 2007: 831; Jazan; Al-Asmari, *et al.* 2009a: 100, 106; Al-Baha, Hail; Al-Asmari, *et al.* 2009b: 618; Riyadh.

[The identification of *C. weneri* may be wrong.]

Compsobuthus longipalpis Levy, Amitai & Shulov, 1973

C. l.; Hendrixson, 2006: 68-71, figs. 12, 13; Makkah District.

***Compsobuthus pallidus* Hendrixson, 2006**

C. p.; Hendrixson, 2006: 71-74, figs. 13, 14, plate 9; Saudi Arabia : 31°40'N 39°30'E, 800 m [near Jordan-Iraq borders].

***Compsobuthus setosus* Hendrixson, 2006**

C. s.; Hendrixson, 2006: 74-78, figs. 13, 15, plate 10; Khashm Khafs; Riyadh; vicinity of Riyadh.

Genus ***Hottentotta*** Birula, 1908

***Hottentotta jayakari jayakari* (Pocock, 1895)**

Buthotus j.; Kinzelbach, 1985: Saudi Arabia.

H. j. j.; Hendrixson, 2006: 78-81, figs. 13, 14, 18, plate 11; Farasan Island (Red Sea).

H. j.; Al-Asmari, *et al.* 2007: 831; Jazan.

Genus ***Leiurus*** Ehrenberg, 1828

***Leiurus jordanensis* Lourenço, Modry & Amr, 2002**

L. j.; Hendrixson, 2006: 82-64, figs. 17, 18, 20a, plates 12-13; al-Uyaynah, 28°55'N 36°03'E, 740 m; al-Tawil, 29°58'N 39°34'E, 840 m [near Jordan borders].

***Leiurus quinquestriatus* (Ehrenberg, 1828)**

Buthus q.; Gough & Hirst, 1927: 5, fig. 8; Medina.

L. q. brachycentrus; Vachon, 1966: 211; ARABIA.

L. q.; Vachon, 1979: 49-50, figs. 8, 37, 46-50, 64-66; Wadi Mizbil; Wadi Durmah; Khamis Mushayt; Wadi Tumeir; Wadi Mutaiwiyah, Mecca Road; Jeddah; Wadi Khumra; Abha-Gizan, km 53; Wadi ad Dilla; Khashm Dibi; Jebel Banban; Jubail; Shi area, al Qunfida; Wadi Fatima; Gizan.

L. q. brachycentrus; Levy & Amitai, 1980: 47; Jidda (Gumfudam).

L. q. hebraeus; Levy & Amitai, 1980: 48-53, figs. 47-51, map 3; Jidda; Medina; Amarna.

L. q.; Hendrixson, 2006: 84-64, figs. 18, 19, 20b-c, plates 14-15; Manfah, 17°36'N 43°39'E; Makkah By-pass km 126; Jabal Sayid, 23°49.5'N 40°57'E, 1000 m; Wadi Shayban; Harrat Kuishm, 23°13'N 41°23'E; Grandi Lavori Road, 19°46'N 41°40'E, 960 m; Camp at al-Baha, 20°10'N 41°25'E, IX.1982; Wadi Knayton, 550-650 m; Khamis; Bani Sar, Baha Province, 20°13'N 41°27'E, 2180 m; al-Foqah, Baha Province, 19°50'N 41°51'E, 1630 m; Wadi Shuqub, Makkah Province, 20°39'N 41°13'E, 1390 m; Harithi, 21°18'N 40°18'E; Wadi Marwani; Wadi Turabah, Makkah Province, 21°N 41°E, 1250 m; al-Hadda, 21°23'N 40°14'E, 2000 m; Khashm Dhibi; Jizan; Jabal Dabbagh, 27°52'N 35°45'E, 2000 m; Jabal Barad, 21°08'N 40°13'E, 2000 m; Wadi Turabah, 1800 m; Jiar, 23°38'N 38°33'E; Wadi Thareira, 21°09'N 40°44'E, 1440 m; wadi 30 km NE of al-Jamun, 21°48'N 39°55'E, 350 m; Hakimah, 17°01'N 42°50'E, 60 m; Wadi Wajj, 21°09'N 40°22'E, 1600 m; Jabal Qishayradh, 21°17'N 40°17'E, 1950 m; 1 ♀, Makkah By-pass km 97, 21°12'N 39°50'E, 225 m; Makkah By-pass km 91.5, 21°15'N 39°48'E, 200 m; Wadi Qatan, 1350 m; Hijla, 14 km E of Abha; 10 km NE of Biljurshi; Shumaisy, 25°06'N 38°43'E, 740 m; an-Naamah, 20°15'N 41°16'E, 2100 m; Baha; Fare, 22°45'N 39°47'E, 850 m; al-Foqah, Baha Province, 19°50'N 41°51'E, 1630 m; Wadi Wajj, 18 km SW of Taif, 1800 m; Wadi Tayyah, 18°32'N 42°14'E, 950 m; Wadi Bani Malik; Wadi Tuweig; Wadi Turabah; Wadi Shuqub; al-Faraah; Adama, 1770 m; Wadi Dhiyan, 19°50'N 41°28'E, 1050 m; Biljurshi, 1840 m; Bani Sar; Wadi Maharish, 1000 m; Wadi Yamaniyah, 1100 m; Wadi Ellah, 20°35'N 41°35'E, 1480 m; Adama, 1770 m; Wadi Asidah, 20°25'N 41°12'E, 1480 m; halfway between Ranja nr. Bisha; Jeddah; Wadi Hanaq; Adama, 1770 m; al-Amar, 25°59'N 50°32'E; Jeddah; Wadi Khumra; Khashm Dhibi; Hesua, Camp 1; Wadi Turabah, 1510 m; Khashm al-Atash; Hudena, 800 m;

Riyadh; vicinity of Riyadh; Wadi Shamruq, 20°29'N 41°19'E, 1600 m; Wadi Mahra, 19°38'N 41°54'E, 2000 m; Grandi Lavori.

L. q.; Al-Asmari, *et al.* 2007: 833; Al-Medina Al-Munawara; Al-Asmari, *et al.* 2009a: 100, 106; Al-Baha, Hail; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Genus **Orthochirus** Karsch, 1891

Orthochirus innesi Simon, 1910

O. i.; Vachon, 1979: 53-55, figs. 36, 38, 55-57; Wadi Mizbil; Wadi Mutaiwiyah, Mecca Road; Al Khardj; Afif, N of Abha; Jeddah; Kushm Dibi.

O. i.; Hendrixson, 2006: 91-95, figs. 21, 23, plate 16; Huraymila, ca. 80 km NW of Riyadh; Nugrah, Janabiyah, 25°36'N 41°28'E, 900 m; Wadi Bani Malik; Wadi Nissah; Hudenah; Khashm Khafs; Wadi Mukhtayn; Khashm Dhibi; Wadi Marwani; Riyadh; Dammam.

O. i.; Al-Asmari, *et al.* 2007: 831, 833; Jazan, Al-Medina Al-Munawara; Al-Asmari, *et al.* 2009a: 100, 106; Al-Baha, Hail; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Genus **Parabuthus** Pocock, 1890

Parabuthus leiosoma leiosoma (Ehrenberg, 1828)

Buthus liosoma; Simon, 1882: 244; Gumfuda.

P. liosoma liosoma; Vachon, 1979: 55-56, figs. 3, 36, 39; Bahara; Abha-Gizan, km 53; Wadi ad Dilla; Shi area, al Qunfida; Jeddah; Burainam, near Jeddah; near Gizan.

P. l. l.; Hendrixson, 2006: 96-99, figs. 22, 23, plate 17; al-Qunfudhah; nr. Abu Arish, 16°58'N 42°50'E, ca. 50 m; Jizan; nr. Jizan, ca. 30 m; Khulais nr. Jeddah; Khashm Khafs; Hesua, Camp 1; Lower Grandi Lavori, 19°35'N 41°39'E, 550 m; Tarfa, 17°03'N 42°21'E; N 30 degrees W 13 km from Shuqayq, 17°50'N 41°57'E, near sea level.

P. liosoma; Al-Asmari, *et al.* 2007: 830; Jazan.

Genus **Vachoniolus** Levy, Amitai & Shulov, 1973

Vachoniolus globimanus Levy, Amitai & Shulov, 1973

Buthacus minipectenibus; Levy, Amitai & Shulov, 1973: 128-130, figs. 27-31; Munegger-Sanam; Gebel Shamar; Naifa.

V. minipectinibus; Vachon, 1979: 49, figs. 12-17, 27, 30, 33, 36; Munegger Sanam; Gebel Shamar; S of Dharan; Khobar; Naifa.

V. g.; Hendrixson, 2006: 100-102, figs. 23, 24, plate 18; Munegger-Sanam; Riyadh.

V. minipectinibus; Al-Asmari, *et al.* 2009a: 100; Al-Baha.

Family **Hemiscorpiidae** Pocock, 1893

Genus **Hemiscorpius** Peters, 1861

Hemiscorpius arabicus Pocock, 1899

H. a.; Vachon, 1979: 59, figs. 41, 44, 45; Al Hair; Kushm Dibi, (South of Riyadh).

H. sp.; Hendrixson, 2006: 103-104, figs. 25, 27, plate 19; Wadi Birk.

H. a.; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Family **Scorpionidae** Peters, 1862

Genus **Nebo** Simon, 1878

Nebo hierichonticus (Simon, 1872) ?

N. h.; Kinzelbach, 1985: Saudi Arabia.

N. spp.; Hendrixson, 2006: 106, figs. 26, 27, plate 20; Munegger-Sanam; Riyadh. Grandi Lavori, 19°45'N 41°40'E, 800-1000 m; USGS Camp at al-Baha, 20°10'N 41°25'E, 2000 m; Buraiman, N of Jeddah; al-Uqdah, Baha Province, 19°35'N 41°07.5'E; Wadi Turabah,

Makkah Province, 21°N 40°E, 1350 m; Jabal Barad, 21°08'N 40°13'E, 2000 m; nr. Abha, 2000 m; Bani Sar, 20°05'N 41°26'E, 2130 m; Hakimah, 17°01'N 42°50'E, 60 m; Jabal Qishayradh, 21°17'N 40°17'E, 1950 m; Dalaghan, Asir, 18°05'N 42°43'E; Baha; Namas, 2380 m; Wadi Maharish, 1000 m; Khaybar/Hail; Leyla; Wadi Bani Malik, at foot of Jabal Ibrahim, 20°27'N 41°09'E, 1400 m; A.M. Al-Maliki, WDS; Wadi Mahra, 19°38'N 41°54'E, 2000 m.

N. h.; Al-Asmari, *et al.* 2007: 831; Jazan; Al-Asmari, *et al.* 2009a: 100; Al-Baha.

Genus ***Pandinus*** Thorell, 1876

Pandinus (Pandinurus) arabicus (Kraepelin, 1894)

Scorpio a.; Kraepelin, 1894: 58-60, fig.10; ARABIA. ?

P. a.; Kraepelin, 1899: 120; Homran, ARABIA.

Pandinus (Pandinurus) exitialis (Pocock, 1888)

P. e.; Vachon, 1966: 215; ARABIA. ?

Genus ***Scorpio*** Linnaeus, 1758

Scorpio maurus Linnaeus, 1758

Scorpio maurus arabicus (Pocock, 1900)

Heterometrus a.; Pocock, 1900: 363; ARABIA.

S. m. a.; Vachon, 1966: 215; ARABIA.

Scorpio maurus fuscus (Ehrenberg, 1829)

S. m. f.; Vachon, 1979: 57-59, figs. 43, 45; camp Khamis Mushayt; Road Taif-Abha, 200-300 km south of Taif,

S. m. f.; Al-Asmari, *et al.* 2009a: 100; Al-Baha.

Scorpio maurus kruglovi Birula, 1910

S. m. k.; Vachon, 1979: 57, figs. 40, 42, 45, 51-53; Wadi Hanifa; petrified forest near Riyadh.

S. m. k.; Al-Asmari, *et al.* 2007: 833; Al-Medina Al-Munawara; Al-Asmari, *et al.* 2009a: 106; Hail; Al-Asmari, *et al.* 2009b: 618; Riyadh.

Scorpio maurus spp.

S. m. spp.; Hendrixson, 2006: 108, figs. 27, 28, plate 21; USGS Camp at al-Baha, 20°10'N 41°25'E, 2000 m; Manfah, 17°36'N 43°39'E; Harithi, Makkah Province, 21°18'N 40°18'E, 1910 m; Bani Sar, Baha Province, 20°13'N 41°27'E, 2180 m; Jabal as-Sinfa, 27°57'N 35°47'E, 300 m; Jabal Sawda, 18°18'N 42°20'E, 2000 m; Hakimah, 17°01'N 42°50'E, 60 m; 31°40'N 39°30'E, 800 m; Hijfa; Namas, 2380 m; Adama, 1770 m.

List of species

Family ***Buthidae*** C. L. Koch, 1837

Androctonus bicolor Ehrenberg, 1828

Androctonus crassicauda (Olivier, 1807)

Apistobuthus pterygocercus Finnegan, 1932

Buthacus buettikeri Hendrixson, 2006

Buthacus yotvatensis nigroaculeatus Levy, Amitai & Shulov, 1973

Butheolus anthracinus (Pocock, 1895)

Butheolus villosus Hendrixson, 2006

Compsobuthus arabicus Levy, Amitai & Shulov, 1973

Compsobuthus fuscatus Hendrixson, 2006

Compsobuthus longipalpis Levy, Amitai & Shulov, 1973

Compsobuthus pallidus Hendrixson, 2006
Compsobuthus setosus Hendrixson, 2006
Hottentotta jayakari jayakari (Pocock, 1895)
Leiurus jordanensis Lourenço, Modry & Amr, 2002
Leiurus quinquestriatus (Ehrenberg, 1828)
Orthochirus innesi Simon, 1910
Parabuthus leiosoma leiosoma (Ehrenberg, 1828)
Vachoniolus globimanus Levy, Amitai & Shulov, 1973

Family **Hemiscorpiidae** Pocock, 1893

Hemiscorpius arabicus Pocock, 1899

Family **Scorpionidae** Peters, 1862

Nebo hierichonticus (Simon, 1872) ?
Pandinus (Pandinurus) arabicus (Kraepelin, 1894)
Pandinus (Pandinurus) exitialis (Pocock, 1888)
Scorpio maurus arabicus (Pocock, 1900)
Scorpio maurus fuscus (Ehrenberg, 1829)
Scorpio maurus kruglovi Birula, 1910
Scorpio maurus sspp.

Key to the scorpion families in Saudi Arabia

1. Pedipalp patella without ventral trichobothria; sternum subtriangular; anterior margin of carapace not conspicuously notched **Buthidae** C. L. Koch, 1837 (804 species)
 – Pedipalp patella with one or more ventral trichobothria; sternum subpentagonal; anterior margin of carapace with distinct notch 2
2. Metasomal segments I-IV with paired ventral submedian carinae; pedipalp chela trichobothrium **ib** located near base of fixed finger; lateroapical margins of tarsi produced into rounded lobes **Scorpionidae** Latreille, 1802 (243 species)
 – Metasomal segments I-IV with single ventromedian carina; pedipalp chela trichobothrium **ib** located midway along fixed finger; lateroapical margins of tarsi straight **Hemiscorpiidae** Pocock, 1893 (83 species)

Key to the genera of Family Buthidae in Saudi Arabia

1. Metasomal segment II widely flared, much wider than other segments of metasoma **Apistobuthus** Finnegan, 1932
 – Metasomal segment II not wider than other segments 2
2. Mesosomal tergites I and II with 5 distinct carinae **Leiurus** Ehrenberg, 1828
 – Mesosomal tergites I and II without carinae, or with at most 3 carinae 3
3. Carapace with distinct carinae 4
 – Carapace smooth or granulated but without distinct carinae 6
4. Central lateral (centromedian) and posterior lateral (posteriomedian) carinae of carapace fused forming a continuous linear row of granules to posterior margin **Compsobuthus** Vachon, 1949
 – Central lateral (centromedian) and posterior lateral (posteriomedian) carinae of carapace do not form a continuous linear row of granules to posterior margin 5

5. Dentate margin of pedipalp chela movable finger with 3 granules located just proximal to terminal denticle and one basal terminal; metasomal segments robust, increasing in width and depth posteriorly **Androctonus** Ehrenberg, 1828
 – Dentate margin of pedipalp chela movable finger with 4 granules located just proximal to terminal denticle and one basal terminal **Hottentotta** Birula, 1908
6. Pedipalp femoral trichobothria arranged in *alpha*-configuration (Angle formed by trichobothria d1, d3, and d4 opens toward external face of pedipalp femur [$<$]); stridulatory patch present on dorsal surface of metasomal segments I-III **Parabuthus** Pocock, 1890
 – Pedipalp femoral trichobothria arranged in *beta*-configuration (Angle formed by trichobothria d1, d3, and d4 opens toward internal face of pedipalp femur [$>$]); stridulatory patch absent 7
7. Carapace, in lateral view, with a distinct downward slope from median eyes to anterior margin; carapace and tergites densely granular; small scorpions (usually less than 30 mm long) 8
 – Carapace, in lateral view, with entire dorsal surface horizontal (or nearly so); carapace and tergites with variable granulation; scorpions of variable size..... 9
8. Metasomal segments IV and V punctate; telson elongate, aculeus as long or longer than vesicle **Orthochirus** Karsch, 1892
 – Metasomal segments ventrally smooth or granulated; telson bulbous, aculeus shorter than vesicle **Butheolus** Simon, 1882
9. Patella of pedipalp with 8 or 9 external trichobothria; carapace smooth to shagreened; male pedipalp chela swollen and globular **Vachoniolus** Levy, Amitai & Shulov, 1973
 – Patella of pedipalp with 7 external trichobothria; carapace granular or smooth; male pedipalp chela not swollen **Buthacus** Birula, 1908

Key to the genera of Family Scorpionidae in Saudi Arabia

1. Telson with subaculear tubercle **Nebo** Simon, 1878
 – Telson without subaculear tubercle 2
2. Stridulation organ located on opposing surfaces of coxae of pedipalps and first pair of legs. Pedipalp patella with numerous ventral trichobothria **Pandinus** Thorell, 1876
 – Stridulation organ absent. Pedipalp patella with 19 trichobothria, 13 of them on external surface **Scorpio** Linnaeus, 1758

Notes on species identification

I. Hendrixson (2006) differentiated among the following species of different genera as follows:

Genus **Buthacus**

1. Metasomal segments densely hirsute **Buthacus yotvatensis nigroaculeatus**
 – Metasomal segments with few setae **Buthacus buettikeri**

Genus **Butheolus**

1. Metasoma and telson densely hirsute; lateral inframedian carinae on metasomal segment IV absent **Butheolus villosus**
 – Metasoma and telson with few setae; lateral inframedian carinae on metasomal segment IV present **Butheolus anthracinus**

Genus *Compsobuthus*

1. Pedipalp chela fingers with outer accessory granules 2
– Pedipalp chela fingers without outer accessory granules 3
2. Lateral inframedian carinae on metasomal segments II and III represented by only a few granules; pedipalp chela fingers extremely elongated *Compsobuthus longipalpis*
– Lateral inframedian carinae on metasomal segments II and III present at least on posterior three-fourths; pedipalp chela fingers not as above *Compsobuthus fuscatus*
3. Sternite VII and ventral surface of metasomal segments with numerous small red setae; pedipalp chela length/depth approximately 7.00 *Compsobuthus setosus*
– Sternite VII and ventral surface of metasomal segments lacking numerous small red setae; pedipalp chela length/depth < 6.00 4
4. Carapacial and tergal surfaces densely, minutely granular; pectinal tooth counts 9-15; nine or fewer rows of granules along dentate margin of pedipalp chela fingers *Compsobuthus arabicus*
– Carapacial and tergal surfaces not as above; pectinal tooth counts 15-18; 10-11 rows of granules along dentate margin of pedipalp chela fingers *Compsobuthus pallidus*

Genus *Leiurus*

1. Base colour dark brown to black; ventrolateral carinae of metasomal segment V with spinoid denticles *Leiurus jordanensis*
– Base colour more or less yellow, often with dusky colouration, but never dark brown to black; ventrolateral carinae of metasomal segment V with lobate denticles distally *Leiurus quinquestriatus*

II. I agree with Hendrixson (2006) that scorpions of both *Nebo* and *Scorpio* need revision. Do all collected specimens of *Nebo* in Saudi Arabia belong to *Nebo hierichonticus* (Simon, 1872), or to other species?

Hendrixson (2006) stated that “a thorough revision, of *Scorpio*, is badly needed”. Three subspecies of *Scorpio maurus* are here listed according to Vachon (1966, 1979). Their identification and their situation may be changed after studying a good material from Saudi Arabia and adjacent countries.

According to the colour plates of Kovařík (2009), *Scorpio maurus fuscus* male has dark body while *Scorpio maurus arabicus* female has a lighter colouration. *Scorpio maurus kruglovi* female has the same colouration of *S. m. fuscus*, while its male has lighter pedipalps and metasoma. However, colouration is not enough to differentiate among species or subspecies. Even, the detailed study of *Scorpio maurus* subspecies by Birula (1910) is not adequate for identification.

III. I could not delete the doubtful (?) records of *Pandinus* from the list. This genus or a similar one was reported from the south of Saudi Arabia, but no available material for examination until now.

Acknowledgments

The queries of Dr. Mahmoud Desouky (University of Ha'il) on scorpion identification, meeting Dr. Ali S. Al-Akel (University of King Saud) during a scientific conference to discuss the study of scorpions in Saudi Arabia, and receiving two recent papers on scorpions of Al-Madina and Hail (MD) and an interesting popular book in Arabic on scorpions prepared by Dr. Mohammad K. Al-Sadoon and Dr. Saud A. Al-Farraj (ASA) activated me to prepare this work. I am indebted to them.

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Eresidae of Sudan (Araneida: Eresidae)

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Abstract

Three species of only one genus of family Eresidae are recorded from Sudan, i.e., *Stegodyphus dufouri*, *S. lineatus*, and *S. manicatus*. The female of *S. m.* is redescribed with notes on its biology and habitat. A key to *Stegodyphus* species in Sudan and a map of their distribution are presented.

Keywords: *Stegodyphus manicatus*, Eresidae, Spiders, Sudan.

Introduction

There are about 80 spider species of 20 families recorded from Sudan. Family Eresidae C. L. Koch, 1850 is one of those families. It includes 100 species and subspecies, of 10 genera, among 40998 spider species all over the world (Platnick, 2009). Only three eresid species of genus *Stegodyphus* Simon, 1873 are recorded from Sudan. All of them are described and figured in the revision of the genus by Kraus & Kraus (1989).

Four juvenile *Stegodyphus* specimens were collected from Sudan on July 2008. They were collected from their nests on trees. Three of them died during transportation to Egypt and only one survived and reared in laboratory until becoming adult female. This adult one was identified as *Stegodyphus manicatus* Simon, 1876 and described below, with notes on its habitat and its biology. The distribution of the three *Stegodyphus* species of Sudan is plotted on a map, in addition to notes on the three species.

Abbreviations used: ALE = anterior lateral eye; AME = anterior median eye; Id = interdistance; L = length; PLE = posterior lateral eye; PME = posterior median eye; TL = total length; W = width. All measurements are in millimetres.

Systematics

Family **Eresidae** C. L. Koch, 1850
“Velvet spiders”

Diagnosis: Small to large (3-35 mm) araneomorph spiders; cribellate; entelegyne; legs with three tarsal claws; carapace convex, rectangular, with eight eyes; median eyes situated close together, with lateral eyes widely spaced; body usually clothed in a dense layer of short plumose setae (Jocqué & Dippenaar-Schoeman, 2006).

Distribution: Mostly Afrotropical and Palaearctic.

Genus ***Stegodyphus*** Simon, 1873

There are 21 species of genus *Stegodyphus*, most of them are recorded from Afrotropical and Palaearctic regions, with 2 species from Brazil and 4 species from Southeast Asia (Platnick, 2009). *Stegodyphus* spiders build their nests and webs on plants. Some of them are social spiders, i.e., living in colonies. The three species recorded from Sudan are solitary or “sub-social” (“non-permanently social” or “periodic-social”) species. The following information about these three species are extracted from literature, mainly from Kraus & Kraus (1989), in addition to photographs of alive specimens to facilitate identification.

Stegodyphus dufouri (Audouin, 1825) Figs. 1-2, 8, 10.

Eresus dufourii Audouin, 1825: 151-152, pl. 4, f. 12 (♀).

Eresus dufourii Audouin, 1827: 376-377, pl. 4, f. 12 (♀).

S. manicatus Simon, 1908: 80 (♂ only, misidentified).

S. niloticus Simon, 1908: 80-82 (♀).

S. d. Simon, 1910: 287, f. 4B (♂♀).

S. manicatus Simon, 1910: 288, f. 4C (♂ only, misidentified).

S. manicatus Berland & Millot, 1940: 158-159, f. 10C-D (♂, non ♀)

S. assumptioni Berland & Millot, 1940: 160, f. 12 (♀ only).

S. d. Kraus & Kraus, 1989: 208-214, f. 104-105, 111-112, 126-131, 142-173, Map 9 (♂♀).

World Distribution: Mauritania, Mali, Algeria, Tunisia, Libya, Egypt, Sudan, Ethiopia, Somalia, Yemen, Senegal, (Upper Volta, Niger, Tchad ?).

Distribution in Sudan:

- El Khandaq (6♀ BMNH 20.10.35; Sudan Agric. Res. Serv. leg. 30.III. 1936).
- Suakim (5♀ 2♀ pre-Epig. ZMB 3897; Stecker leg. X. 1886).
- Wadi Halfa (1♀ Holotype of *niloticus* MNHN AR929).

Stegodyphus lineatus (Latreille, 1817) Figs. 3-4, 9, 11.

S. l. deserticola Simon, 1908: 79 (D).

S. l. Simon, 1910: 286-287, f. 4A (♂♀).

S. l. deserticola Simon, 1910: 287 (♀).

S. l. Kraus & Kraus, 1989: 231-235, f. 1-2, 28, 202-205, 227-228, 234-242, pl. 3 (f. A-E, G), Map 7 (♂♀).

World Distribution: Spain, Italy, Greece, Turkey, Palestine (Israel), Jordan, Syria, Iraq, Iran, Uzbekistan; Mauritania, Morocco, Algeria, Tunisia, Libya, Niger, Tchad, Egypt, Saudi Arabia, Sudan, Yemen.

Distribution in Sudan:

- Khartoum (1♀ pre-epig. MRAC 120.761; Cloudsley-Thompson leg. 1960-61).

***Stegodyphus manicatus* Simon, 1876** Figs. 5, 6, 12-22.

S. m. Simon, 1876: 87 (♀).

S. m. Simon, 1908: 79-80 (♀, non ♂).

S. m. Simon, 1910: 288 (♀ only, ♂ = *S. dufouri*).

S. m. Berland & Millot, 1940: 158-159, f. 10A-B (♀, non ♂ = *S. dufouri*).

S. assomptioni Berland & Millot, 1940: 159-160, f. 11 (♂, nec ♀).

S. m. Kraus & Kraus, 1989: 218-220, f. 108, 114-115, 188-194, Map 6 (♂, ♀).

World Distribution: Senegal, Mali, Niger, Tchad, Sudan, Ethiopia. Mostly south of the Sahara (Kraus & Kraus, 1989: 249, Map 6).

Distribution in Sudan:

- Khartoum (1♀ MRAC 123.051; Cloudsley-Thompson leg.).

- Kassala (1♂ MRAC 133.678; Clarkson leg. 1951).

- Suakim (1♀ ZMB [ex 3897]).

[BMNH = The Natural History Museum, London, United Kingdom

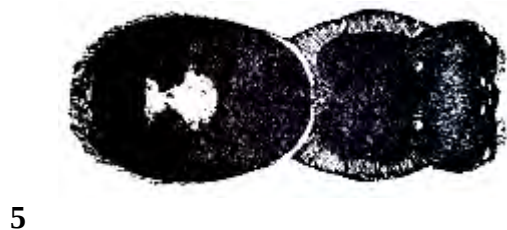
MNHN = Muséum National d'Histoire Naturelle, Paris, France

MRAC = Musée Royal de l'Afrique Centrale, Tervuren, Belgium

ZMB = Museum für Naturkunde, Humboldt-Universität, Berlin, Germany]



Figs. 1-5. Habitus, dorsal view. 1-2. *Stegodyphus dufouri* (Audouin, 1825) 1. ♂. 2. ♀. (Specimens from Egypt.) 3-4. *Stegodyphus lineatus* (Latreille, 1817) 3. ♂. 4. ♀.



5. *Stegodyphus manicatus* Simon, 1876 ♂.
[Fig. 11A, after Berland & Millot, 1940: 159]

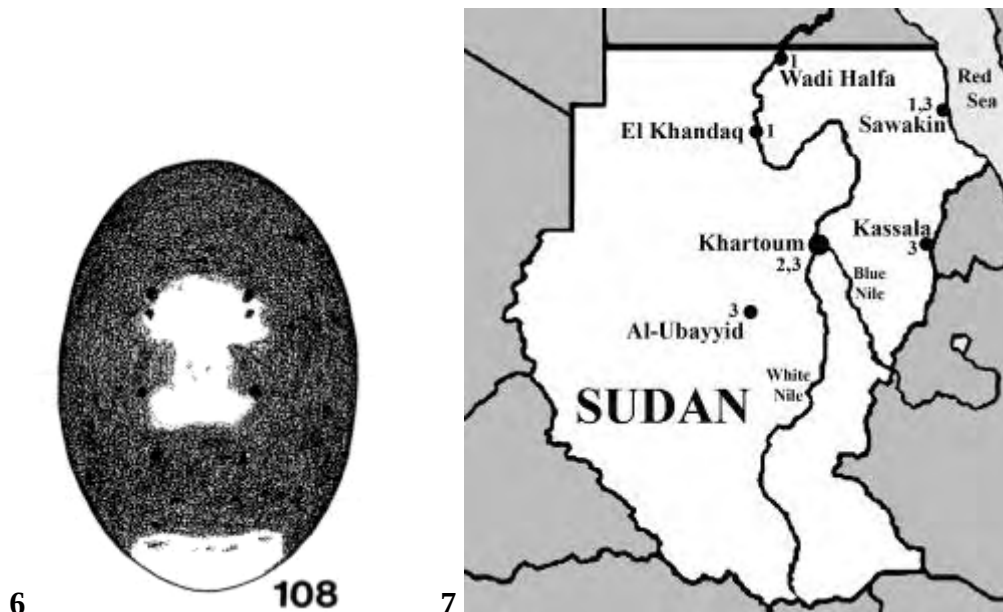


Fig. 6. *Stegodyphus manicatus*, dorsal colour pattern of opisthosoma (♂).
[Fig. 108, after Kraus & Kraus, 1989: 200]

Fig. 7. Distribution map of *Stegodyphus* species of Sudan.

1 = *Stegodyphus dufouri*, 2 = *Stegodyphus lineatus*, 3 = *Stegodyphus manicatus*.

[Wadi Halfa 21°47'35"N, 31°22'16"E; El Khandaq 18°36'00"N, 30°33'60"E;

Sawakin 19°06'01"N, 37°19'56"E; Khartoum 15°34'48"N, 32°31'12"E;

Kassala 15°27'36"N, 36°23'24"E; Al-Ubayyid 13°12'11"N, 30°19'22"E]

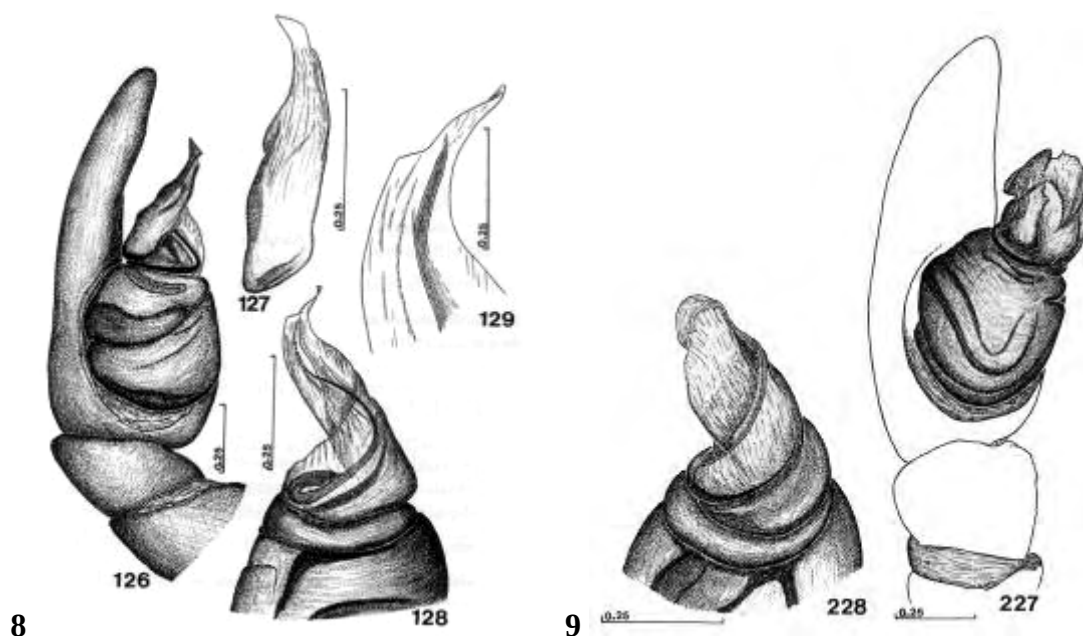


Fig. 8. Male pedipalp and terminal lamella of *Stegodyphus dufouri*, Egypt, Djebel Mokattam. [Figs. 126-129, after Kraus & Kraus, 1989: 203]

Fig. 9. Male pedipalp and terminal lamella of *Stegodyphus lineatus*. [Figs. 227-228, after Kraus & Kraus, 1989: 229]

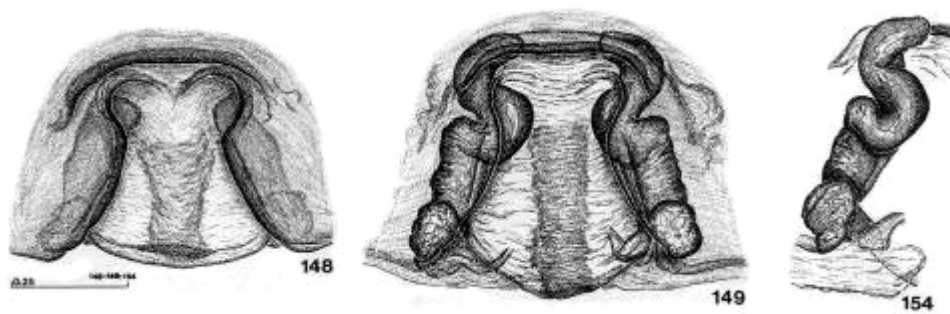


Fig. 10. *Stegodyphus dufouri* epigynum and vulva, type of *niloticus*. 148-149. Ventral view, 154. Dorsal view. [Figs. 148-149, 154, after Kraus & Kraus, 1989: 210]

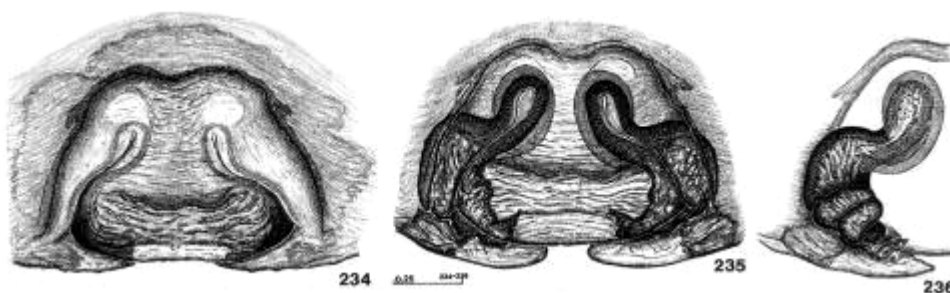


Fig. 11. *Stegodyphus lineatus* Epigynum and vulva. 234-235. Ventral view. 236. Vulva, dorsal view. [Figs. 234-236, after Kraus & Kraus, 1989: 230]

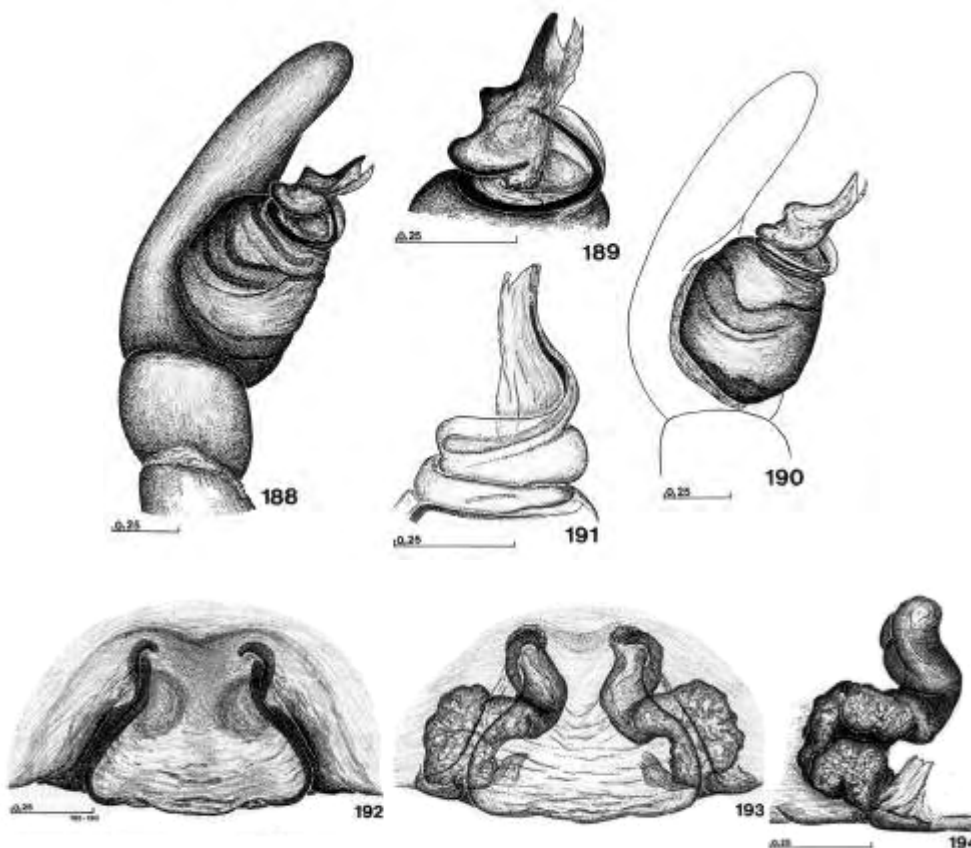


Fig. 12. *Stegodyphus manicatus*. 188-191. Male pedipalp and details of terminal lamella [188-189: type of *assumptioni*, 190-191: other specimen]. 192-194. Epigynum and vulva, ventral and dorsal view [type of *manicatus*]. [Figs. 188-194, after Kraus & Kraus, 1989: 219]

Key to *Stegodyphus* species in Sudan

<i>Stegodyphus</i>	<i>dufouri</i>		<i>lineatus</i>		<i>manicatus</i>	
	♂	♀	♂	♀	♂	♀
L leg I : L cephalothorax	3.1-3.2	2.4-2.9	2.8	2.2	2.5-2.9	2.2
W PME : W AME	1.2	1.0-1.3	1.2	1.2	1.4-1.5	1.4-1.5
Abdominal pattern	Fig. 1	Fig. 2	Fig. 3	Fig. 4	Figs. 5-6	---
♂ Palpal organ	Fig. 8		Fig. 9		Fig. 12	
♀ Epigynum and vulvae		Fig. 10		Fig. 11		Fig. 12

Stegodyphus manicatus from Kordufan, Sudan (Figs. 13-22).

Description: Female (Fig. 18): TL 16.142; Cephalothorax (Fig. 16) L 5.95. Cephalic part: L 3.825, W 3.57; L : W = 1.07; elevated, reddish orange, covered by white hairs, except ocular region, frontal region of prosoma, clypeus and chelicerae covered by black hairs. Thoracic part: L 2.125, W 3.825; L : W = 0.55; colouration similar to cephalic part, but with sparse white hairs. Eyes: transparent; AME and PLE equal; posterior medians (PME) largest, slightly larger than anterior laterals (ALE) and 1¼ times larger than anterior medians (AME) and posterior laterals (PLE). Median ocular area wider than long. Eye measurements (diameters and interdistances): AME 0.204, ALE 0.238, PME 0.255, PLE 0.204, AM-AM 0.238, AL-AL 2.414, PM-PM 0.374, PL-PL 2.006, AM-AL 1.09, AM-PM 0.136. (Id PME : Id AME = 1.57; Id PLE : Id ALE = 83.09%). Chelicerae: covered by dense black hairs. Sternum dark orange. Labium and maxillae: reddish orange, except internal parts white. Pedipalps: dark orange, covered by black hairs on first and second segments. Legs: orange yellow, covered by white hairs. Metatarsus and tarsus IV blackish. Leg II darker than III & IV. Leg I darker than II, with dense black hairs on femur, prolaterally and ventrally, and tibia, only prolaterally. Calamistrum about ⅔ the length of metatarsus IV retrolaterally (Fig. 17).

Table 1: ♀, Legs measurements (mm).

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total length
I	4.081	2.385	2.65	2.915	1.59	13.621
II	3.339	1.749	1.908	1.749	1.06	9.805
III	2.12	1.696	1.431	1.59	0.795	7.632
IV	3.71	2.226	2.65	2.385	1.113	12.084

Relative length of legs 113 : 81 : 63 : 100. Leg formula I-IV-II-III.

L leg I : L cephalothorax = 2.29.

Spination pattern: ventrally: two distal spines on metatarsus I; two distal + two median spines on metatarsi and two distal spines on tibiae II-IV; none elsewhere.

Abdomen: L 10.192; Creamy white dorsally and ventrally, covered by short hairs (Figs. 15, 19). Cribellum bipartite (L 0.583). Epigynum (Fig. 20), W 0.612 ventrally after separating and clearing, and vulvae similar to those figured by Kraus & Kraus (1989: Figs. 192-194) (Fig. 12) except the distance between vulvae, which are contiguous in Kordufan's specimen (Figs. 21-22).

Distribution: *S. m.* was previously recorded from Khartoum, Kassala, and Suakim (Sawakin) (Kraus & Kraus, 1989). The new material studied was collected near Al-Ubayyid: 3 juveniles, from Khor Tagget (13°12'11.5"N, 30°19'22.2"E, Alt. 559m), near Faculty of Science, Kordufan University, 28 July 2008, in their webs on bark of *Adansonia digitata*, Tabaldi tree (Baobab); 1 juvenile, from its nest among *Acacia*

bagworm cocoons (*Auchmophila kordofensis*), on *Acacia nubica* tree, beside the road from Al-Ubayyid to Kazgail (13°06'15.9"N, 30°11'17.3"E, Alt. 585m), 29 July 2008 (Fig. 7).

The described female was one of those collected juveniles, reared in Khartoum and Cairo. Only two moults were observed, 18 August 2008 and 17 September 2008. She lived until 27 June 2009 and preserved on the next day.

Biology and Habitat

The male type of *S. assomptioni* was “captured in the garden of the governor inside a small lodge of silk fixed on a shrub’s branch” (Berland & Millot, 1940: 160). Kordufan juvenile specimens were found in their webs on bark of *Adansonia digitata*, Tabaldi tree (Fig. 13) and among *Acacia* bagworm cocoons (*Auchmophila kordofensis*) on *Acacia nubica* tree.

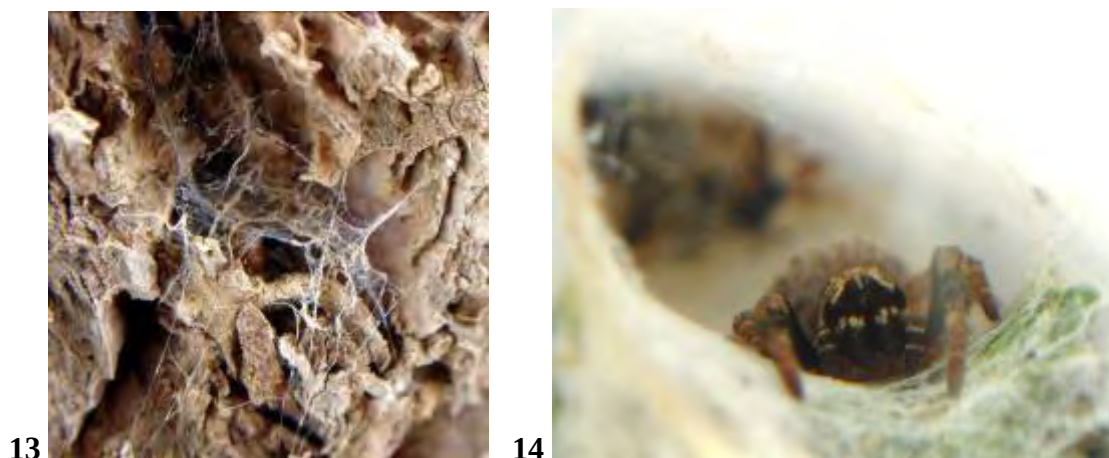


Fig. 13. Web of juvenile *Stegodyphus manicatus* on tree trunk bark.
Fig. 14. Juvenile *Stegodyphus manicatus* at nest's entrance.



Fig. 15. Subadult female seizing her prey, *Musca domestica*.
Fig. 16. Female's cephalothorax. Fig. 17. Female's calamistrum on metatarsus IV.

In west Africa, Millot & Bourgin (1942: 299) reported the presence of *S. manicatus* in a colony. Kraus & Kraus (1989: 220) had seen 13 females from Niger col-

lected together with their large nest that showed funnel-like tubes. They reported that “Various cocoons contained nymphs and the succeeding instar; they must have been produced nearly simultaneously, i.e., by different females”. They stated “It is not quite clear whether the species may occur in colonies or may perhaps (!) be a social-living species”.

S. manicatus juveniles, subadults and adult were reared on different kinds of prey, i.e., bees, wasps, flies, and sometimes caterpillars (Fig. 15). They were very fast in attack and in subduing the prey. They built dense silk nests, each with a single entrance. The colouration of the juvenile was slightly different, with less black hairs on frontal region of prosoma, chelicerae, and legs (Fig. 14).



Fig. 18. *Stegodyphus manicatus* Simon, 1876. ♀.

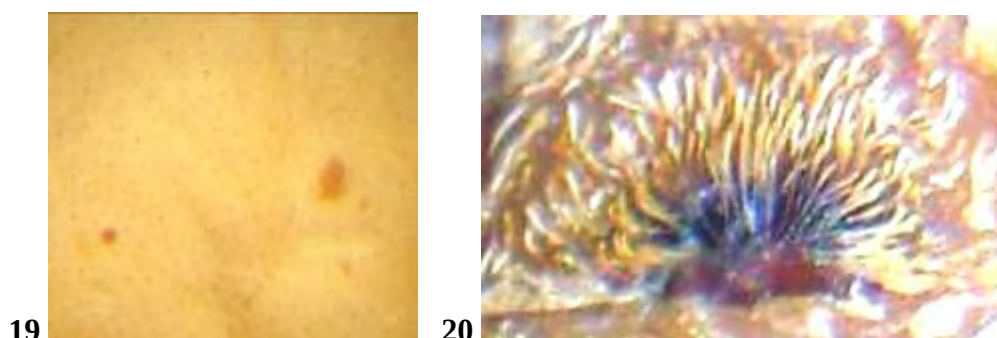


Fig. 19. Cuticle of adult female's abdomen. Fig. 20. Epigynum, ventral view.

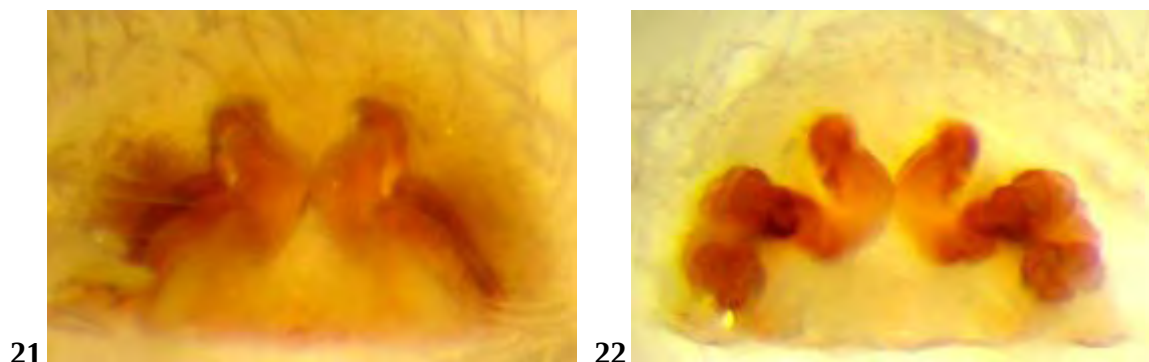


Fig. 21. Epigynum, ventral view, after separating and clearing.
Fig. 22. Vulvae, dorsal view.

Acknowledgments

I am grateful to Prof. Dr. Tigani M. H. Allam, the director of the Natural History Museum, University of Khartoum, who invited me to visit Sudan (23 July - 10 August 2008). His generosity, his kind help and his wide scope of both culture and science are unforgettable. My sincere thanks are due to all Sudanese colleagues who helped me during my visit to Sudan and made me eager to study its fauna.

I am grateful too to Prof. Dr. Mashaal A. Saleh, the dean of Faculty of Science, Kordufan University who made my visit to Kordufan possible and hosted me there.

My sincere thanks are due to my Sudanese friends Fathy, Serr, Sara, and Aasem who helped me much during my visit to Kordufan.

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